









# THE COCCIDAE

TABLES FOR THE IDENTIFICATION OF THE SUBFAMILIES AND SOME OF  
THE MORE IMPORTANT GENERA AND SPECIES TOGETHER WITH  
DISCUSSIONS OF THEIR ANATOMY AND LIFE HISTORY

BY

ALEX. D. MACGILLIVRAY

*I will speak what I believe to-day,  
even if it contradicts everything that  
I said yesterday.* Gladstone.

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TO  
MY FORMER STUDENTS OF THE COCCIDAE WHO THROUGH  
THEIR INSISTENCE ARE RESPONSIBLE FOR THE  
COMPLETION AND PUBLICATION OF  
THIS VOLUME



## PREFACE

The following materials were originally collected for the use of students in the identification of coccids. They were based upon printed descriptions and original studies of specimens. There were, when the tables were first prepared, no extensive or limited analyses that could be used for this purpose. The first plan was to arrange analyses of all the genera and species of all the subfamilies, but it was soon found that this was impractical. The first draft was prepared about fifteen years ago. This was later greatly extended, modified, revised, and mimeographed for issuance to students.

The mimeographed edition contained the following preface: "The tables given herewith are compilations to facilitate the determination of species. In making the compilations, numerous studies were made on the phylogeny of the different subfamilies, genera, and species and the results of the studies thus made are embodied herein. Although compilations from descriptions in the main, yet they contain names not used elsewhere (all those marked MacG.) and hence unpublished. The preparation of mimeographed papers does not constitute publication according to the rules of systematic zoologists. Hence these new names and this manuscript has no standing in entomological literature. In justice to the writer, therefore, the names and tables given herewith should be considered the personal property of the writer and are not to be referred to by any person using the tables in any paper that may be published until after the names and facts here given have been printed in such a way by the writer as to be recognized as published by zoologists." This statement is included in order to fix the status of the mimeographed copies in case any of them should find their way into libraries.

Besides the preparation of the tables there was accumulated from various sources in addition to my own studies upon specimens, many facts bearing upon the preparation, anatomy, metamorphosis, and habits of coccids. These facts were presented to the students in the form of a course of lectures. Most of the students who have taken this coccid course have been provided with a set of the mimeographed tables. I have had many requests from former students and others to purchase the tables or asking for permis-

## PREFACE

sion to be allowed to copy them and, when these requests have been denied have urged that the material might be printed and made available for the use of all. For this reason the accumulated materials have been again revised and extended and are offered on the following pages.

The number of separate publications or papers dealing with the family Coccidae is legion. Mrs. M. E. Fernald prepared a catalogue which gives references to the literature dealing with all the species. This catalogue is of inestimable value to every student of the Coccidae. The numerous titles to papers have not been accumulated thus far by any one and I have given a considerable list of the books and papers dealing with the family. No attempt has been made to make it complete.

The fact that no figures are included in this volume may appear to many as an error. The tables were prepared primarily for the use of students. Those who have had any experience in teaching know that most students will not undertake anything they are not forced to do. The omission of figures makes it necessary for them to study their specimens rather than figures.

A careful examination of the figures and descriptions of the species of Diaspidinae has made it possible to refer a considerable number of the species to the generic groups recognized in this volume. A number of species, however, either from the meagerness of their descriptions or the imperfections of their figures, have been included under the generic group where they were originally described. Further investigation will show that some of these species are misplaced.

The materials accumulated are from such varied sources, that it is impossible to name all the authors. I take this opportunity to acknowledge my indebtedness to all students of the Coccidae for the material that I have culled from their writings. The following are deserving of special mention: Berlese, Cockerell, Comstock, Green, Hempel, Kuwana, Leonardi, Marlatt, Maskell, Newstead, and Signoret. I am also greatly indebted to all my former students of the Coccidae for many suggestions and criticisms of the form and arrangement of the various tables and of the characterizations used therein.

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July 15, 1920.

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# THE COCCIDAE

## CHAPTER I

### INTRODUCTION

The subdivision of the body into a series of somewhat similar rings or areas and the modification of the external surface of the rings into a hardened skeleton or cuticle are important characteristics. They denote that any animal possessing them is an Arthropod. The rings, known as segments, are separated by distinct constrictions or infoldings. A portion of each infolded portion, known as a conjunctiva or coria, is generally different in color and more flexible. The presence of a pair of segmented appendages on each or a few of the segments is a further indication of an arthropodan relationship. The fact that the segments are assembled into three groups or regions, a cephalic region or head which is apparently unsegmented but in reality consists of six segments, an intermediate region or thorax consisting of three segments, and a caudal region or abdomen consisting typically of eleven segments, is an indication of an affinity with the hexapods or insects. This relationship is usually emphasized by the presence of a pair of legs on each segment of the thorax, the absence of legs on the abdomen, and the modification of the appendages of the segments of the head into mouth-parts. The evidences of relationship of coccids to arthropods and insects are in part wanting in many coccids and are all wanting in some.

The insects of the order Hemiptera, to which the family Coccidae belongs, possess typically the following characteristics. The constriction between the head and prothorax, the procoria, is distinct. The coria between the prothorax and mesothorax, the mesocoria, is also distinct, while the one between the mesothorax and metathorax, the metacoria, as well as the coria between the metathorax and the first abdominal segment, the unacoria, are usually more or less obscure. The head bears a pair of compound eyes, a pair of antennae of varying size and shape, and three pairs of mouth-parts. These latter are of the sucking type. Two of the

pairs of mouth-parts, the mandibles and the maxillae, are long, slender, bristle-like appendages that are similar in appearance. The third pair, the labium, is in the form of a long segmented tube which is fitted for sucking and piercing and is known as the rostrum. This tube is normally folded against the ventral aspect of the head and thorax. It contains a longitudinal furrow which is open on the dorsal aspect. The sides of this furrow are adjacent, forming a lumen in which the bristle-like mandibles and maxillae are held and supported. Each segment of the thorax bears a pair of legs, which consist of the usual number of sclerites or segments. The mesothorax and metathorax usually bear also a pair of wings. The thorax generally bears two and the abdomen a varying number, never more than eight and usually about six, pairs of spiracles. Certain coccids lack all these features indicating relationship with the Hemiptera except the presence of two pairs of thoracic spiracles and of a thin external body skeleton or cuticle.

The great diversity and peculiarity in the form of many coccids and the similarity to them in general external appearance of certain species of some of the related families of Hemiptera has led even some specialists into the error from time to time of describing insects other than coccids as such. All orders of insects can be divided into two large groups according to the number of tarsal segments, in one group would fall those with five segments, assumed to be the primitive condition, and in the other those with less than five segments. The Hemiptera and the closely related orders of Exometabola with sucking mouth-parts belong to the group with less than five tarsal segments. This latter group can be divided into two series upon the size of the pronotum and the condition of the wings. In one of the series the mesothoracic wings are modified into veinless wing-covers or elytra and the pronotum is a large subquadrangular area loosely articulated to the mesonotum, while in the other group the wings, although sometimes thickened, are never modified into elytra and the pronotum is reduced in size, collar-like and immovably united with the mesothorax. The Hemiptera and their allies, which belong to the latter series, are easily separated from all other insects with tarsi of less than five segments, because their mouth-parts, in immature individuals as well as adults, are fitted for sucking. It is very unusual to have immature insects with sucking mouth-parts.

The form and structure of the sucking mouth-parts of the orders with less than five segments in their tarsi are sufficiently distinctive and typical to differentiate them from each other. The

characters recorded in the following table will serve not only to separate these orders from each other, but will also serve to separate them from all the other orders of insects:—

- a. Legs normal in form, fitted for walking or swimming, never scansorial or with tibia and tarsus and claw of each leg combined to form an opposed thumb and finger for clinging to hairs; labium modified into a distinct always exposed sucking tube, if wanting, thorax with a single pair of wings or the tarsi with a single claw or legs wanting.
- b. Tarsi with the distal segment bladder-like or hoof-like in form; wings long, narrow, subequal in size, margins parallel and fringed with setae as long as the width of wing; labium a conical tube enclosing one mandible and two maxillae; maxillae and labium provided with palpi; clypeus asymmetrical in the adult; legs and mouth-parts always present.-----PHYSSORODA.
- bb. Tarsi with the distal segment never bladder-like or hoof-like in form; wings triangular or subtriangular in outline, one of the wings of each side usually larger than the other, never with margins parallel and fringed with long setae; labium a segmented tube enclosing bristle-like mandibles and maxillae; maxillae and labium never provided with palpi; clypeus always symmetrical; legs and mouth-parts sometimes wanting.-----HEMIPTERA.
- aa. Legs abnormal in form, never fitted for walking or swimming, always scansorial or with tibia and tarsus and claw of each leg combined to form an opposed thumb and finger for clinging to hairs; labium modified into a sucking tube that is usually retracted and concealed; wings always wanting and legs always present.-----ANOPLURA.

The Anoplura or lice are generally included as a suborder of Hemiptera under the name of Parasitica. The evidence that they are degraded Hemiptera is not very conclusive. The form of their mouth-parts, a closed sucking tube without mandibles or maxillae, is very different from that of the species of this order. The order Hemiptera can be characterized more definitely and the Anoplura more easily differentiated from the Hemiptera if it is considered as a distinct order.

The order Hemiptera is usually divided into three suborders, Heteroptera, Homoptera, and Parasitica. The last of these has been recognized as a distinct order as already indicated. The texture of the wings, the shape and position of the head, the point of attachment and structure of the labium or rostrum, the form of the tarsi, and the form, size, and presence of the antennae are the characteristics generally used to distinguish the suborders Heteroptera and Homoptera. The difference in the form of the

antennae and in the general appearance of the families of this suborder, as generally recognized, has led to its subdivision into two groups or suborders. The structure of the wings, the form and origin of the mouth-parts, and the presence of many other minor differences emphasize the desirability of this subdivision:—

#### SUBORDERS OF HEMIPTERA

- a. Head with rostrum attached to its cephalic end, distant from the prothoracic legs, ventro-meson of the head distinctly longer than the distance on the venter between compound eyes; mesothoracic wings, when present, with proximal portion thickened and distal portion membranous. -----HETEROPTERA.
- aa. Head with rostrum attached to its ventral aspect near the articulation of prothoracic legs, ventro-meson distinctly shorter than distance on the venter between compound eyes; mesothoracic wings, when present, always of same texture throughout, never thickened on proximal and membranous on distal portion.
  - b. Antennae minute and inconspicuous, setiform or awl-shaped; tarsi with three segments; prothorax large and conspicuous.-----HOMOPTERA.
  - bb. Antennae long and filiform, rudimentary, or wanting, never setiform or awl-shaped; tarsi with one or two segments; prothorax small and frequently inconspicuous. -----GULAROSTRIA.

The suborder Heteroptera as here defined includes the superfamilies and families usually assigned to it. The suborder Homoptera includes the superfamilies Cicadoidea, Jassoidea, Fulgoroidea, and Membracoidea, while to the suborder Gularostria is assigned the Psyllidae, Aphididae, Aleyrodidae, and Coccidae. These groups can be separated by means of the following table:—

#### FAMILIES OF GULAROSTRIA

- a. Tarsi of adult rarely with less than two segments and usually with two claws, legs never wanting; wings, when present, four in number; eyes in adult always compound, if present in nymph, compound; rostrum always present in nymphs and adults, usually greatly elongated and projecting beyond the mesocoxae; adult insects never scale-like, grub-like, or gall-like in form and never immovably fixed to the food plant; nymphs sometimes scale-like, legless, and immovable, if so, abdomen always provided with a vasiform orifice.
- b. Wings, when present, membranous; the metathoracic wings always much smaller than the mesothoracic; body of adult and its wings sometimes bearing filaments, threads, or tufts of wax, never densely covered with a fine, white, and powdery wax; nymphs and adults frequently associated, subsimilar in form, both provided with antennae and legs, both capable of locomotion, nymphs never provided with a vasiform orifice.

- c. Antennae with eight to ten segments; rostrum with three segments, reaching to mesocoxae; metacoxae near together, about length of their coxae apart; adults always provided with wings, veins arising as branches from both sides of a short median proximal stem; nymphs with body usually strongly depressed, wing pads horizontal and usually ending beyond the body, -----PSYLLIDAE.
- cc. Antennae with three to six segments; rostrum with four or five segments, reaching to and frequently beyond the mesocoxae; metacoxae distant, four or five times as far apart as the length of their coxae; adults winged or wingless, veins arising as branches from the caudal margin only of a large cephalic vein; nymphs with body cylindrical, rarely depressed, wing pads not horizontal and usually held against the body, -----APHIDIDAE.
- bb. Wings membranous and rarely absent in adult; metathoracic wings subequal in size to mesothoracic; body of adult and wings always densely covered with a fine white, powdery wax; nymphs and adults sometimes closely associated, always different in form, adults insect-like, nymphs always scale-like or grub-like in form and never covered with a white waxy powder, frequently with marginal plates of wax, always without antennae and legs, and abdomen always provided with a vasiform orifice, -----ALEYRONIDAE.
- aa. Tarsi of the adult rarely with more than one segment and always with a single claw, legs frequently wanting; wings, when present, two in number; eyes in adult and nymphal female never compound and frequently wanting, wanting in nymphal male and rarely compound in adult male; rostrum very short, rarely reaching mesocoxae or as far as metathoracic spiracles if mesocoxae are wanting in female, wanting in older nymphal stages and always in adult male and rarely wanting in adult female; adult male usually winged and insect-like, adult female scale-like, grub-like, or gall-like in form, frequently imbedded in mass of wax of its own excretion, frequently fixed to the food plant and immovable; legs and antennae frequently greatly reduced in size, rudimentary, or wanting in nymphal and adult females; abdomen never provided with vasiform orifice, -----COCCIDAE.

The members of the family Coccidae live upon the stems, leaves and roots of plants. While a great majority of the species are fixed to the host-plant for at least a part of their life, some are always active. The fixity or quiescence of the different species is confined for the most part to the female sex and is always associated with the production of eggs and young. There is the greatest diversity in the external form of coccids. This is due more to the form of the waxy excretion with which the body is covered than to the general form of the body itself. The amount of wax and the form it assumes are also associated with reproduction. There is frequently considerable variation in the external

appearance of different individuals of the same species due to their being crowded into crevices and depressions upon the host-plant and also to the close crowding together of the different individuals. While there is considerable variation in the form and structure of the body, these differences are always so minute that they can not be seen without the aid of a microscope and many of them are difficult to interpret even by the use of a microscope of considerable magnification. In the classification of coccids the early systematists used the superficial characters, those based on the shape and consistency of the wax. Comstock demonstrated not only the validity of the structural characters of the pygidium, but used them in differentiating species of Diaspidinae so that it is now possible with a considerable degree of accuracy to identify species of this subfamily. The genera and species of the other subfamilies are still based to a large extent upon superficial characters.

The greatest development in number of genera and species is found in tropical and subtropical regions, but many genera and species extend into and are peculiar to temperate regions. The number of peculiar or bizarre species that have been described from Australia and the islands connecting this continent with the Asiatic mainland is large. While certain species of coccids are found only upon certain plants and frequently only upon certain parts of the plant, other species whether limited to a particular part of the plant or not may occur on all the species of plants of a genus, of a family, or all the families of an order. Some species are found apparently indiscriminately upon almost any plant, regardless of its taxonomic association and upon any part of the plant but the roots. Only a few coccids feed upon the roots of plants. They are peculiar to this situation and belong as a rule to particular coccid genera.

The individual insects are usually small and inconspicuous and easily overlooked. While this is true of most coccids, some of the species of the generalized subfamilies attain a size of one inch or more. Many of the large or medium sized species are conspicuous in the adult stage because of the mass of white wax which surrounds their body or its attachment to it. This is particularly true of colonies of *Pulvinaria* which are usually overlooked until they begin to form their ovisacs. The amount of wax excreted by the female before and during the deposition of her eggs varies with the subfamily and to a certain extent with the species. Some females excrete a long ribbon of doughy wax five

or six inches long as in *Takahashia*. In certain of the species forming an abundance of wax, it is a thick homogenous mass and in the case of *Tachardia*, the shellac forming insects, the wax is an important article of commerce. A long time, several weeks to three months, is sometimes required in the production of the ovisac, as in *Leerya*. The small species may become conspicuous from the large number of individuals present in a given area, this is also increased sometimes by the color, as in the case of the male scales of *Chionaspis* and *Aulacaspis*. The number may be so large that the surface is completely covered or encrusted and hence the name of scale insects. Most of the species that occur in considerable numbers, as the species of *Aspidiotus*, *Lepidosaphes*, or *Chionaspis*, form only a minute leaf-like disk of wax and molted skins. The females of *Leerya* and of other large species when they are ready to form their large conspicuous ovisacs, seem to congregate in the same place so that many adjacent ovisacs are frequently found close together.

The coccids and aleyrodids of all the insects that undergo a direct or incomplete metamorphosis show the farthest departure from the generalized orthopteran type of metamorphosis. In the case of the Coccidae there is more difference between the two sexes throughout the greater part of their life than exists between many species of insects of other families or orders.

When the recently emerged coccid is compared with the diagnosis of a typical hemipterous insect and of a gularostrian, it is seen that there is still retained most of the features peculiar to these types. The most striking change is the modification of the compound eyes into a pair of simple eyes or ocellanae, the great reduction in the size of the constrictions between the head and prothorax and the prothorax and mesothorax, the procoria and the mesocoria, so that it is often difficult to determine the limits of the head and of the thoracic segments. The antennae and legs, while they are typical in form so far as segmentation and number of parts are concerned, are different in appearance. They are large and ungainly in appearance and are apparently out of all proportion in size with the remainder of the body. This is not true of other nymphal Hemiptera or of nymphal insects in general.

The two sexes, while so different throughout the greater part of their life, are indistinguishable during the first nymphal stage. The nymphs, when they emerge from the egg, remain perfectly quiescent for a time, a few hours to two days, in the place where the eggs were laid. These young nymphs are suddenly seized with



a desire to get out and wander. It acts upon them suddenly as if they were seized with hysteria, they become not only active but they literally swarm out over the branches of the host-plant until frequently it is completely covered. The function of this migration period is apparently for the dissemination of the species and to find an unencumbered portion of the host-plant where the nymph can attach itself and begin to draw food.

The generalized coccids are active throughout their entire nymphal life and in some even throughout their entire life as the females of the genus *Orthezia*. The great majority are quiescent during the adult stage. It would not be strange, therefore, to find that the length of the active period had been shortened and the quiescent period lengthened from just the adult condition to practically the entire life of the insects. The quiescent period in many specialized coccids begins just as soon as the migrating nymphs of the first nymphal period fix themselves to the host-plant. In many species the appendages, including the legs and antennae, and even the mandibles and maxillae in the male, but not the labium or rostrum, are lost at the first molt, so that the animals are capable of only slight movements.

The males are easily identified after their entrance into the quiescent period which is after the first molt in the *Eriococcinae*, because the mouth-parts are wanting. They can usually be identified a short time before the first molt in mounted specimens. The developing mandibles and maxillae of the female which are functional during the second stage can be identified as a coiled watch-spring-like structure within the cuticle on each side of the rostrum. These coiled structures, since the mandibles and maxillae are wanting in the second and following stages of the male, are never present in the first nymphal stage.

The nymphal males usually molt about four times and there are four nymphal stages. The young nymphs form a cocoon or scale from threads of wax at sometime before or near the beginning of the quiescent period. This quiescence may begin early in the second nymphal period or it may be delayed to as late as the fourth nymphal period. The molted skins are usually pushed out under the nymphal case or scale as they are cast. The nymphal appendages and legs are lost at the molt when the male enters the quiescent period. The appendages of the adult, including a single pair of wings in most males, are developed from imaginal discs. It has been maintained by some that the male coccid passes through an indirect or complete metamorphosis. Their determination is based upon the presence of a quiescent period during the

latter part of the nymphal life and by some to the fact that the wings are developed from imaginal discs. The great variation in the length of the quiescent period and the development of the wings of all insects with an incomplete metamorphosis from imaginal discs would show that the hypothesis that the male coccid has a complete metamorphosis is without foundation. This is further accentuated by the fact that the wings of the male coccid are always developed externally, never internally, as in all insects with an incomplete metamorphosis.

The adult male is identical in form with the hemipterous type except that the bristle-like mandibles and maxillae are wanting and the rostrum is represented by a slight conical projection. The mouth-parts are often incorrectly stated to be wanting. The statement that the ventral pair of ocellanae are developed from and replace the mouth-parts is groundless. The transverse constrictions between the segments of the body, the coriae, are of the usual insectean type and always more distinct than in the first nymphal stage.

The females are generally stated to have an incomplete metamorphosis. This has probably arisen through the absence of wings which are the most important external structures that can be used in determining what type of metamorphosis exists. It is safe to conclude, however, since the male has an incomplete metamorphosis and that the members of the other families of this order have a typical incomplete metamorphosis that the females of this family have a similar type. The females of the different genera show a greater diversity in the number of nymphal stages than the males. There may be two, three, or four molts and a corresponding number of nymphal stages. It is an interesting fact that the generalized female coccids have the same number of molts as most of the males and that it approximates the condition found in most insects. There is a direct correlation between the specialization of the structures of the female and the reduction in the number of molts. The most specialized species exist in only three conditions or stages, two of which are nymphal. The first nymphal stage is an active one for migration and location, the second nymphal stage is for feeding and growth, and the third stage or adult stage is for the production of eggs or young. The developing female differs from the male in that she departs farther and farther after each molt from the form and structure of hemipterous and other insects while the males approximate them closer and closer in form. The females become grub-like or bag-like while the males become insect-like.

The transverse constrictions of the body of the female in each succeeding nymphal stage after the first become more and more obscure, until in the adult females of many species the coriae are wanting or so indefinite that it is impossible to determine, except in a general way, the caudal extent of the head. The eyes are represented by a single ocellana on each side of the head or are wanting. The body increases in size and becomes plumper so that the antennae and legs do not appear so long and large and out of proportion to the remainder of the body. The adult females of many coccids are without legs and frequently, where they are retained as in most Coccinae, they do not project beyond the lateral margin of the body.

The female like the male may pass through a quiescent period and, as in the case of the male, it varies greatly in length. The legs and antennae which are wanting in most of the nymphal stages of Margarodes are regained in the adult. The function of the quiescent period is entirely different, not only for the making over of the organs and tissues of the body, but for the production and laying of eggs or for the giving birth to young. In a few cases, as the Ortheziinae, the female never becomes quiescent. She excretes a sack of wax which remains attached to her body. The eggs are deposited in this sack, which is carried about until the eggs hatch and the young nymphs emerge from the free and open end. In the great majority of the species, generalized as well as specialized, the female forms a mass or sack of wax or a scale which is attached to the host-plant. This wax, which varies greatly in consistency, is either interposed between the body of the female and the host-plant or forms a covering over her body or completely encases her body in a flocculent or dense mass. It is the color of the wax, which is generally white, that makes the individuals or colonies of coccids conspicuous and attracts attention to their presence.

The members of the family Coccidae are of great economic importance because of the injuries that they do to growing plants. They subsist upon the sap which they obtain by means of the tube formed by the close apposition of the bristle-like mandibles and maxillae. Even if the great diversity and complexity of their metamorphosis, their complicated anatomy, and the different ways in which they produce substances useful to man were not considered of sufficient importance to warrant spending so much time on the study of these insects, sufficient reason is found in the great number of injurious species belonging to this family and the enormous amount of damage which they do.

## CHAPTER II

### PREPARATION

The characters used for the separation of the various sub-families, genera, and species of Coccidae are confined almost entirely to the females. The reason for this is that the males are rarely encountered unless special efforts are made to locate them or to breed them. They are consequently not so well known and have not been subjected to such extensive studies as the females which, if found at all, usually occur in considerable numbers. It is not strange, therefore, that the classification has been based on the structures and excretions of the female. All individuals, either from their size or from the presence of the excretions which cover them, need to be treated with chemicals before their finer structures can be examined.

The body in the great majority of the species is small. In many it is microscopic in size. Whether the body is large or small, it has been greatly modified, specialized by reduction, so that there is an astonishing simplification of the external form. In certain adult females the body is hardly more than a simple cuticular bag. The external appendages and the structures associated with them have been modified, greatly reduced in size, or are wanting. The great number of species and the dearth of usable characters, because of the simplification of their external form and structure, makes it necessary to employ every available structure. The females have their bodies covered with wax. The amount of wax varies with the species, the volume excreted by some is much greater than the volume of their bodies. The wax must be removed and the body and its appendages clarified so that the form and structure of the various parts can be determined.

The difficulty is apparently further increased by the fact that in most cases the specimens usually available for study are the dried wrinkled bodies of females that have laid their eggs and that have been stored in museums from a few to many years. The bodies of such individuals must be removed so that all parts can be examined. It is desirable that the body be returned as nearly as possible to its original form, to that of the living individual.

This can be accomplished fortunately just as readily from specimens that have been dried for a long period of years as from fresh or living specimens.

The dried specimen is transformed by treating it with chemicals which will not only dissolve the wax, but soften the cuticle, expand the wrinkles until the body is of its original size and shape, and clarify the dark and clouded portions. The making of a good preparation of a coccid is not an easy matter. It does not consist in dumping some specimens roughly and carelessly into a dish with certain chemicals, and, then by juggling them through a series of other dishes and chemicals, expect them to come out a finished product. Those who undertake the task with this attitude of mind have a sad awakening before them and the fewer number of bunglers of this type who undertake the preparation and study of the classification of the Coccidae, the better off the subject will be. The making of a good preparation is an operation that requires time, unbounded patience, and skill in manipulation. It frequently occurs even when all of these are applied to the very best of one's ability that a large proportion or all of the resulting mounted specimens may be practically worthless for study. There is no easy road to follow at such times. The only thing to do is to try again and to keep on trying until preparations that will answer every necessity of the case are secured.

**Equipment.**—The making of good microscopic preparations presupposes that the preparator is provided with all the necessary tools, chemicals, and glassware. A considerable equipment is desirable but not essential in the preparation of coccids. Such an outfit is not in use continuously and it is frequently advantageous to remove the bottles and glassware at such times from the table. This is more easily accomplished if it is arranged in a drawer that can be shoved into a locker or cabinet. The outfit named below can be arranged compactly in a drawer eighteen inches long, twelve inches wide, and three inches deep. If an inch board with holes bored in it in which the various bottles and jars will fit, is placed in the bottom of the drawer, there will be less shifting about and the various vessels will always be in their proper places.

Such a drawer should be provided with the following articles:—

1. Rubber stoppered bottle for ten per cent caustic potash and holding 500 cc.
2. Glass stoppered bottle for 95 per cent alcohol and holding 500 cc.

3. Glass stoppered bottle for distilled water and holding 500 cc.

4. Glass stoppered bottle holding 100 cc. for staining solution.

5. Bottle with dropper for carbol-xytol and holding 250 cc.

6. Stender jar, 60 x 90 mm. for clean slides.

7. Stender jar, 60 x 35 mm. for clean cover-glasses.

8. Stender jar, 60 x 90 mm. for burnt matches.

9. Ointment jar for waste. A large covered jar, preferably one of the colored glass jars sold as ointment jars, about three and one-half inches broad and about six inches high, is needed into which can be drained waste liquids as used caustic potash, water, and alcohol. A quart fruit jar can be used if nothing else is available.

10. A jar of xytol balsam with a solid glass rod.

11. Box of safety matches.

12. Bunsen burner stand with shelf. The best type is that where one of the legs is provided with a shelf which can be raised or lowered and fastened in place with a set screw.

13. Alcohol lamp. Better results can be obtained by the use of an alcohol lamp than by the use of a gas flame. The alcohol lamp should be of good size so as not to need refilling too frequently. Care should be used not to fill the lamp too full or when it gets hot the alcohol may explode.

14. Casserole with cover and wooden handle. The best vessel in which to boil coccids is a casserole about three and one-half inches in diameter and holding about four ounces. Any sort of chemical glassware, as beakers or test tubes, can be used, but, when considerable heat is applied to caustic potash, causing it to boil vigorously, it is liable to pop out of any vessel with a restricted mouth or neck and to carry the specimens with it. There is no danger from popping-out if a wide-mouthed vessel such as a casserole is used. It will be found that the wooden handle will save burnt fingers and temper.

15. Syracuse Watch-glasses. The watch-glasses with flat bottoms and grooved so that they can be stacked up are the most convenient receptacles in which to perform many of the operations necessary in the treatment of the specimens, as dehydrating, staining, or clearing. A considerable number, twenty-five or more, will be found useful. Those with the beveled surface ground, upon which the name of the substance or the name or number of the

*insect can be written with an ordinary pencil, are the most convenient.*

The student should supply himself with a good stock of slides and cover-glasses. The slides should be of the ordinary size, 75 x 25 mm., with ground edges. There are two kinds, those known as thin or extra thin which have the advantage that twice as many can be stored in an ordinary slide box, those known as thick slides which require more space but they are not so easily broken.

The cover-glasses should be No. 1 as to thickness and not over 15 mm. in diameter and preferably only 12 mm. The use of small covers, where the great majority of the objects to be mounted are minute, saves time in locating the specimens under the cover.

Slides and cover-glasses as they come from the dealer are greasy and should always be cleaned before using. The slides should be placed in water containing about five per cent of ammonia or in 95 per cent alcohol acidulated with one per cent of hydrochloric acid. The cover-glasses should be placed in acidulated alcohol. They should be added to the solution one at a time so that the solution will cover all parts and should remain in it for five or six hours. The slides and covers should be wiped with a towel or piece of cheese cloth and stored in covered jars until needed.

**Tools.**—The person making preparations of coccids should be provided with the following tools:—

1. Forceps.—The forceps should have fine smooth points without corrugations of any sort. The spring should be weak. This serves a double purpose, they will not tire the hand so quickly and there is less danger of injuring the specimen, since only slight force is needed to close them. Two pairs of such forceps will often be found convenient.

2. Dissecting Needles.—The needles with a fixed ebony or aluminum handle with straight points are best. Two are essential, more will be found convenient.

3. Embryo Knives.—Dissecting needles with a spear point, one with a double cutting edge and one with a single cutting edge.

4. Section Lifter.—One with a small, thin, flexible blade.

5. Scissors.—A pair 115 mm. long with fine curved points.

6. Pipettes.—The rubber bulb should hold 2 cc. and the glass tube should be long, straight, and with a large opening. One at least for each kind of solution used.

7. Brushes.—Two artist's sable brushes of different sizes will

be found very convenient at times for handling, transferring, and cleaning specimens.

**Clarifying.**—The removal or dissolving of the wax excreted by all or certain cells of the hypodermis and the making of the body translucent is known as clarifying. This can be accomplished by the use of several substances, the best of which is a solution of caustic potash.

The body of the insect or the wax surrounding it is usually closely attached to the host-plant. It must be detached in such a way as not to injure the finer microscopic parts which are frequently located along the margin of the body. This margin is ordinarily distinct since the body is generally more or less depressed in the adult female. In many species the characters used for differentiation are the presence and absence and form of minute setae or setae-like projections which are easily destroyed. The specimens should be separated from the host-plant with a fine dissecting needle under a binocular or simple microscope or a hand lens. Where the body is encased in a homogenous mass of wax, this should be placed directly into the clarifying solution. In the Diaspidinae the body of the insect is covered by a composite scale consisting of wax excreted by the insect and one or two cast nymphal exuviae which are imbedded in the wax. The body of the insect is located beneath the scale and can be exposed in most cases by simply turning the scale over. In certain species the body can be separated from the scale only with great difficulty, this is due to the presence of a pronounced ventral scale. Where it is difficult to separate the insect from the scale, the scale and the enclosed insect should be placed in the clarifier. When the insect is exposed, the dried body should not be lifted or handled by holding it between the file-like or even smooth points of a pair of forceps. Moisten the point of the dissecting needle or of the forceps with water, alcohol, or caustic potash, or on the tongue and lift the specimen with the moistened tool. It is frequently desirable to mount some of the nymphal exuviae of the female attached to the scale, since they frequently show characters not found on the body of the insect itself. In certain genera of the Diaspidinae the last or second nymphal exuvia is not molted and it must be broken open to obtain the body of the insect.

The best solvent of the wax is a solution of caustic potash. It is also the best substances for expanding the body and making it translucent. A ten per cent solution, made by adding ten grams of stick potash to ninety cubic centimeters of distilled water, is



*the best strength to use.* The effect of a very strong solution is different from that of a weak solution which destroys the cellular structures. Distilled water should always be used in making the solution, if this is not available, fresh rain water should be used. Water containing lime or tap water that has been filtered with chemicals should never be used in making a solution of caustic potash or used in washing specimens. When such water is used, the various chemicals form linear or spine-like crystals in the specimens. It is often desirable to use a weaker solution than ten per cent, such a solution can readily be made by diluting the stock solution one-half, one-third, or one-fourth as desired, making about five or three or two per cent solutions.

In large species and those with globular bodies, it will often be found desirable to separate the dorsal and ventral surfaces and mount the two portions side by side under the same cover-glass. Large species after they have been boiled for a time often have large opaque masses within them. The body in such cases should be punctured and the hard opaque mass removed. The source of these masses is not known. If the specimen is left in the caustic potash until the mass is dissolved, the specimen will be ruined. The time necessary for the clarification of any particular species varies with the individual. Some specimens of a species will clear quickly while others will take considerable time. The specimens should at all times be given careful attention. The length of time required will need to be modified with each species. This can be determined only by observing the rapidity of the clarification.

Those specimens in which the body is soft or the cuticle is thin must be handled carefully so as not to puncture or tear the cuticle unnecessarily, but particularly so as not to get the body out of shape. This applies especially where the body is bag-like in form. Species that normally have the body depressed are liable to become distorted or decidedly compressed. Many specimens become so distorted that considerable time is required to unravel the relation of the various parts. This distortion is due to one or both of two causes, carelessness in handling the specimens with the forceps or carelessness in boiling them too vigorously, frequently the latter. Specimens that are badly distorted, unless they are very rare, are not worth the time required to mount them. When the caustic potash for clarifying or the water for washing is boiled vigorously, the specimens are forced to the surface of the liquid and into the greatly agitated surface film. This has the effect of flattening out the specimens, folding them compactly, and twisting

and mixing the appendages. If there are several specimens in the liquid, the mixing and fastening together may be so complete that it is practically impossible to separate them. It is a waste of time to try and untangle such specimens, they are worthless for mounting, unless they are very rare species.

Since the above was written, one of my students, J. Howard Gage, has shown that specimens, no matter how badly they may be tangled and distorted, can be separated and inflated in the following manner. The specimens to be inflated should be washed as described later and placed from the water or from alcohol in a watch-glass containing chemically pure lactic acid. They should remain in this solution from three-fourths to one hour and then be placed in another watch-glass containing sulphuric ether or chloroform, preferably the former, for fifteen to thirty minutes. The inflation occurs while in this latter solution and when completed the specimens should be separated and as plump as in life. An immersion in 95 per cent alcohol is needed to remove the ether and for dehydration.

There is always difficulty, except in the case of large specimens, in transferring them from one solution to another, particularly if the transferring is to be done without injury to the specimens. It should be done with a section lifter, pipette, sable brush, or forceps. The forceps, while apparently more difficult to use, will be found the best at all times for this purpose. The specimens, whether large or small, should never be grasped between the points of the forceps. This will break off fine projections or distort the body. The specimen should be floated from the bottom and taken up in the fluid enclosed between the points of the forceps. This method will seem almost impossible at first, because of the difficulty of getting the specimens, particularly small ones, through the surface film. The knack of doing this is readily acquired, if the preparator is persistent. It will soon be learned, if tried, that it is not as easy as it may seem to transfer specimens with a section lifter for the same reason. Float the specimens around in the fluid after each change is made so that they will return, if slightly distorted, to their original form.

The clarifying with hot caustic potash is the method most generally followed and may be known as the fast method. The use of a cold solution may be known as the slow method. The heat hastens the action of the caustic potash and it is possible to make preparations in a few hours by the fast method which would require several days by the slow method.

The fast method consists in placing the specimens removed from the host-plant in a casserole into which should be poured enough caustic potash to cover the bottom to a depth of one-fourth to one-half inch. The cover should be added and the solution should be heated until it just simmers. If the solution becomes in *great part evaporated before the specimens are clarified, either more caustic potash should be added or some distilled water.*

The slow method differs from the fast method in that a cold solution is used. The specimens clarified in this way will need from eight hours to several days depending upon the size of the specimens, the amount of wax, and their opacity. Either Syracuse watch-glasses or four drachm homeopathic vials should be used. This method does away with a great part of the handling of the specimens and the chance of breakage from the boiling solution. The fluids can be decanted off, if desired, and the specimens left in the vials or watch-glasses. This method is not practical for those species that require a long treatment, even by the fast method, as many Coccinae. It is especially useful in preparing specimens of Diaspidinae, which are usually clarified by a treatment over night. The action can be hastened by pouring a hot solution into the vials containing the specimens. Hot solutions should not be used with the watch-glasses as the danger of breakage from the heat is considerable.

Other substances can be used for dissolving the wax, as carbon bisulphide, sulphuric ether, xylol, or chloroform. The last of these is the only one of much value. The powdery or cottony wax, when present in small quantities, can be dissolved with chloroform. It does not expand shrivelled specimens and its most important use is in preparing specimens of Diaspidinae where good preparations of the fringe are especially to be desired. Specimens can be mounted in xylol balsam directly from the chloroform.

**Washing.**—The specimens after the clarifying is completed need to be thoroughly washed in distilled water in order to remove all traces of the caustic potash. If the fast method was used, the specimens can be boiled in distilled water. The washing can be done whether the fast or slow method was used, by soaking the specimens for an hour or more in cold distilled water. They should be transferred from the casserole, if the fast method was used, to watch-glasses or vials, if already in such receptacles, the caustic potash can be poured off and replaced by water. The specimens should be carried through several changes of distilled water, three to five, whether they are boiled in it or not.

**Hardening.**—When the washing is completed, the specimens should be transferred to 95 per cent alcohol. If the specimens are hardened by remaining in this solution for about twenty minutes, they, particularly the soft baggy ones, will be greatly benefited. This step can be omitted if desired.

**Staining.**—If the specimens are to be stained, the general rule is that they should be transferred from the hardening solution to the stain if an alcoholic stain is used and to water and then to the stain if an aqueous stain is used. This will be found unnecessary if the stain recommended on a following page is used as specimens can be placed in the stain from either water or alcohol. While it takes more time to stain specimens, the greater ease with which they can be studied and the much greater visibility of many characters that are just or not at all perceptible in unstained specimens, more than repays for the extra time required.

Many solutions have been suggested, as safranin, gentian violet, picric acid, picro-cresote, Delafield's haematoxylin, fuchsin, säurefuchsin, and carbolie fuchsin. Some writers have confused fuchsin and säurefuchsin and their various commercial names. Fuchsin is a basic stain containing rosanilin, and is variously known as fuchsin, analin red, rubin, rosein, magenta, etc. Säurefuchsin is an acid stain containing rosanilin and known as acid fuchsin, fuchsin S, acid rubin, saurerubin, acid magenta, and säurefuchsin. Gage, who experimented extensively with these various stains and most of the others named, concluded that the best results were obtained by the use of an aqueous solution of säurefuchsin. As he pointed out, one of the great difficulties with stained specimens of coccids is that they may be sharply stained and well differentiated when mounted, but in the course of a few weeks or months they have lost all trace of the stain. The fading of säurefuchsin was shown to be due to the presence of caustic potash in the specimens. The washing of the specimens needs, therefore, to be done with great care and thoroughness and, if there is any question as to the complete removal of the caustic potash, the specimen should be washed in acidulated water or alcohol, 1 cc. hydrochloric acid to 99 cc. distilled water.

The staining should be done while the specimens are in vials or watch-glasses. It will require from ten to forty minutes, depending upon the size of the specimens and the condition of their cuticle. If the specimens are overstained, the excess stain can be removed with a dilute solution of caustic potash, one-half per cent

to one hundred cc. of water. This should be followed by acidulated water or alcohol.

The following formula for Gage's Säurefuchsin contains considerable hydrochloric acid in order to reduce any caustic potash there may be left in the specimens:—

Säurefuchsin .....	0.5 gr.
Hydrochloric acid, 10 per cent.....	25.0 cc.
Distilled water .....	300.0 cc.

The excess of stain should be removed by washing with distilled water. The use of acidulated water will sharpen the color of the stain. The longer the specimen has to remain in the caustic potash beyond a certain time, the more difficult it will be to stain.

A stronger solution, one gram of säurefuchsin to the same amount of water and hydrochloric acid, will be found advantageous. This is particularly true in staining individuals with a very thin cuticle and in staining specimens of Eriococcinae from which the anal ring is to be dissected and mounted separately under a cover.

**Dehydration.**—The removal of the water from the specimens, if they are to be mounted in a resinous media, as Canada balsam, is known as dehydration. The water must be removed because the balsam and water are not miscible. If a nonresinous mounting media is used, as glycerin jelly, dehydration is unnecessary. If the specimens are to be cleared in a clearer containing carbolic acid, the dehydration can be done in commercial or 95 per cent alcohol, otherwise absolute or 98 per cent alcohol should be used. The dehydration is best done in a vial or watch-glass. The specimens should remain in the alcohol for at least fifteen minutes. If a complete dehydration is not accomplished, the specimens become cloudy or foggy, have a whitish aqueous bubbly appearance, a short time after they are placed in the balsam. Time will be saved by allowing the specimens to remain in the alcohol for a sufficient length of time to insure a complete dehydration. If the specimens become cloudy, remove the cover-glass and return the specimens to the clearer and then give them a thorough dehydration. They should then be returned to the clearer and mounted in balsam again. The same alcohol should not be used too long, renew the supply from time to time.

**Clearing.**—The placing of the specimens in a solution that is miscible not only with alcohol but with the resinous mounting media is known as clearing. It can be done in a watch-glass or a

vial or on a slide. The specimens should remain in the clearer for fifteen minutes or more. Where the specimens are to be mounted in a nonresinous media as glycerin jelly, clearing is unnecessary. The following substances can be used for clearing, chloroform, xylol, cedar oil, oil of bergamont, benzol, turpentine, synthetic oil of wintergreen, carbol-turpentine, carbol-xylol, and oil of cloves. The last two give excellent results.

The oil of cloves can be used after dehydration with commercial alcohol. It differs greatly in shades of color, a light colored oil should be used. Specimens cleared with clove oil become very dark colored with age.

One of the most practical clearers for use with coccids is carbol-xylol. It can be used after commercial alcohol, clears rapidly, evaporates slowly, and specimens do not discolor with age. The solution is prepared by combining one part by measure of the melted crystals of carbolic acid with three parts of xylol.

If it is inconvenient to complete the preparation of the specimens immediately, they should be removed from the caustic potash, washed, and stored in alcohol. A stay of a few hours in alcohol will not injure stained specimens, but a stay of two or three days in alcohol or carbol-xylol does effect the intensity of the stain. An examination of stained cleared specimens of large individuals in a watch-glass is often very advantageous. Such specimens should be placed in clove oil for study. If the specimens are to be mounted after the completion of the examination, they should be placed in 95 per cent alcohol to remove the clove oil and for dehydration and then cleared in carbol-xylol.

**Mounting.**—The specimens after clearing are ready for mounting in a resinous mounting media, as Canada balsam. They in most cases are minute and the use of cover-glasses one-half inch or twelve millimeters in diameter will be found more economical of time when the specimens are studied. Several specimens, except in the case of large species, can be placed under a single cover-glass. The specimens should be arranged in a row, thus [ ] [ ] [ ] and sufficient very thin balsam to cover them added. The balsam should be allowed to harden for a short time and fasten the specimens in place. When sufficiently hardened, add enough balsam to fill the space under the cover and carefully put the cover-glass in place. Do not use more balsam than is absolutely necessary, the preparation must be thin if an oil immersion objective is to be used. In order to secure thin preparations, the balsam should be diluted until it is about as thin as water. If

spaces unfilled with balsam appear a few hours after completing the mounting, put a minute drop of the balsam at the edge of the cover adjacent to the unfilled spaces and allow it to run under the cover. If the balsam gets thick, it can be thinned by the addition of xylol, chloroform, or benzol, depending upon the solution originally used to dissolve it. The solution in xylol is the one most generally used. Specimens should never be mounted in the natural or unthinned Canada balsam. Such balsam will never harden and the preparations, where it is used, are always soft and sticky. When the mounting is completed or before the slides are handled much, they should be heated gently by placing them on a steam radiator or over an alcohol lamp to drive off the xylol and to fasten the cover-glass in place. Care must be used in heating with a lamp not to allow the balsam to boil and fill the preparation with bubbles.

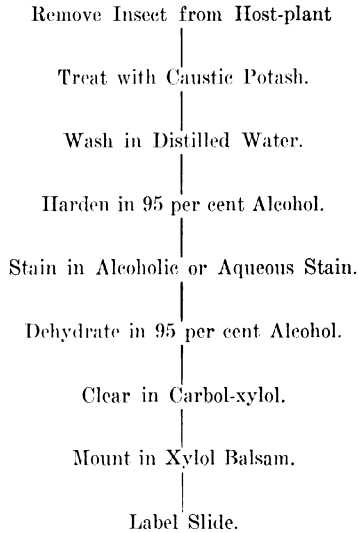
Specimens mounted in glycerin jelly have the advantage of being more opaque than those mounted in balsam. Such preparations are likely, especially if stored in a warm place, to have the mounting media disintegrate and the preparations become worthless for study. Such specimens can be remounted by placing the slides in hot water and dissolving the glycerin jelly. They can then be remounted in the glycerin jelly or dehydrated and cleared and mounted in balsam. The prepared glycerin jelly can be purchased from dealers in microscopic supplies.

**Labelling.**—Each slide should be carefully labelled. This should be done as they are completed. The labels should be written with India ink or waterproof ink. Ordinary writing fluids become illegible in a few years. It is always of great advantage to mark the slide in such a way that the mounted specimens can be connected up with the original lot of material from which they were obtained.

**Rapid Method.**—While many entomologists depend upon the external appearance of the scale in the Diaspidinae, the only absolutely safe method of identification is a study of the characters of the body of the insect itself. Considerable time is required to make a preparation for such a study. A preparation showing the pygidial fringe will often serve every purpose. Glycerin jelly alone or combined with glacial acetic acid, nine parts of the glycerin jelly to one of the acetic acid, is used for making such preparations. The acetic acid acts as a clearer and its addition is an advantage. The specimens should be removed and placed on a slide with just sufficient of the glycerin jelly to mount the specimens. The slide

should be heated slowly over an alcohol lamp until the glycerin jelly is melted and surrounds the specimens. The heating should be continued until the mounting media has thoroughly penetrated the specimens, gently boiled if necessary. Care must be used not to get the slide too hot and burned or heated until the glycerin jelly is all evaporated. The cover-glass should be added when the heating is completed. The pygidial fringe is easily followed in such specimens and often other structures of the pygidium can be identified.

The following formula shows the procedure for the potash method :—





## CHAPTER III

### EXTERNAL ANATOMY

The sclerites and sutures of the Hemiptera even in the species of the most generalized families are generally modified in form and distinctness from the same parts in all insects of the orthopteran type. In the specialized Gularostria the sutures are effaced for the most part. The intersegmental coriae are frequently wanting in the Coccidae and, when present, are usually indicated only as slight transverse furrows. A study of the external anatomy of the coccids consists in an examination and identification of the body regions, the appendages, and the numerous new or secondary structures that have arisen as a result of their peculiar mode of life.

The body of a coccid, while different in external form from that of most Hemiptera, has retained certain characters showing conclusively their relationship to the other families of the order. The variation in external structure is not limited to differences from the other families of the order, but there is a great dissimilarity in form even among the various subfamilies of Coccidae, particularly among the adult females. This difference has undoubtedly resulted from the dissimilarity in their habits and from the diverse ways in which the females shield their progeny. Eggs are laid in many species and they are protected by a waxy covering which varies greatly in form, consistency, and position in the different genera. With the variation in the waxy excretion there is a corresponding variation in the structures of the body of the insect that produces the excretion.

The two sexes, as pointed out, are very different in size, form, and structure. The adult males are distinctly insect-like in form. Their parts are normal in form and arrangement and do not differ markedly, except in the loss of mandibles and maxillae, from those of other winged insects. The adult females on the contrary are usually more or less grub-like in form. They possess many structures not found in the males. The classification is based almost entirely upon the females and the following descriptions unless otherwise stated refer only to them.

**Body-wall.**—The exterior covering or body-wall of coccids is composed of the three layers common to other insects, cuticle, hypodermis, and basement membrane.

The hypodermis is a single layer of pavement epithelium or cuboidal cells. It is the living part of the body-wall and excretes the cuticle and the wax in which the body is imbedded or by which it is covered. The wax varies in form according to its method of excretion. In such genera as *Ceroplastes* and *Tachardia*, where the wax is a homogenous mass, it is considered as excreted by all of the hypodermal cells and as poured out through the cuticle. In most coccids the wax is excreted by special cells of the hypodermis which have been greatly modified and enlarged. Careful detailed studies of the form of the wax excreting hypodermal cells, the wax cells, has been made in only a few species. Such cells are usually more numerous during the adult than during any of the nymphal stages and are fewest in number during the first nymphal stage. In many genera certain wax cells are wanting or are not functional until during the adult stage as the genacerores of the *Diaspidinae*. The openings of these cells are usually located on the ventral aspect of the abdomen or are associated with the external opening of the oviduct, the vulva. They excrete the wax in which the eggs are enclosed.

The inner ends of the hypodermal cells are bound together by a thin semicuticular layer, the basement membrane. This membrane, so far as is known, does not perform any important function in the *Coccidae*.

The outer layer of the body-wall is the outer skeleton, cuticula, or cuticle. It is generally comparatively thin and flexible in this family. The cuticle and the internal skeleton are the only portions not only of the body-wall but of the body remaining after the coccid has been subjected to an extended treatment to caustic potash. It is, therefore, incorrect to consider any of the parts remaining after such a treatment as glandular structures or apply names to them that would suggest such a condition. When the body is studied in section, the cuticle is found to be indefinitely lamellate. The outer thinner portion, hardened by the deposition of chitin, is usually darker in color and inelastic. It is the outer portion that is discarded when the insect molts. The much thicker inner portion is elastic and permits of the increase in size or growth of the body at stated intervals when the outer layer of cuticle is cast off or molted. The cuticle covers not only the outer surface of the body but lines the cephalic and caudal portions of the lumen of the alimentary canal, the air tubes or tracheae, the ducts of the salivary glands, and the caudal portion of the ducts of the reproductive organs. It also forms the basis of the internal skeleton

or endoskeleton of the head and thorax when these are present.

**Setae, Spinulae.**—The cuticle bears appendages of different kinds, as setae, spinulae, and cerores, the openings through which the wax is poured from the wax cells.

Each of the hair-like appendages borne by the cuticle is a seta. They are generally designated as hairs or spines although they are entirely different in origin from both of these structures. The setae are hollow, open at the distal end, and are formed by special hypodermal cells. Each seta consists of a slender thread-like portion, the shaft, which is articulated in a small cup in the cuticle, the alveolus or calyx. It appears as a depressed circular area when the shaft is in place and when broken off the shaft shows as a minute irregular stub in the bottom of the depression. The presence of the calyx is the only certain means of proving whether any given projection is a seta or not. The opening in the shaft of the seta, the lumen, connects with an opening extending through the cuticle, the pore canal or trichopore, which terminates at the large cell secreting the seta, a trichogen cell. This cell forms the seta and in most cases is apparently formed by the fusion of several adjacent cells which have lost their body-wall, since the trichogen cell always contains several independent masses of nuclear matter. The setae are probably primarily sensory in function and are connected with the nervous system. The trichogen cells often elaborate an excretion which is poured out through the pore canal and the lumen of the seta. The wax of coccids is never excreted from cells of this type so far as known. The cuticle bearing each seta is sometimes produced pimple-like, as in *Icerya*. The swollen portion of the cuticle together with the seta which it bears is known as a chalaza. The extent of the cuticle can always be determined from the position of the calyx. The wax excreted by the wax cells is never poured out through setae, the seta-like projections of *Orthezia* lack calices. The spines of insects are extensions of the body-wall into which the hypodermis extends and frequently bear setae. True hairs are found only in the Vertebrata.

The surface of the cuticle may be prolonged into numerous minute projections which are frequently seta-like. These projections are known as solid setae, solid hairs, or spinulae. They lack not only the calyx of the seta but also its lumen, are not formed by special hypodermal cells, and are usually inflexible.

**Cerores, Ceratubae.**—The setae and spinulae are projections of the cuticle. It usually contains in addition to these in the

family Coccidae minute microscopic openings through which the wax is poured. These openings vary greatly in form and arrangement, are sometimes borne on minute projections, and are known as cerores. They are also known as pores, glandular pores, wax pores, or spinnerets. The cerores are sometimes borne on minute projections of the cuticle and for this reason have been considered as appendages of the cuticle.

The simplest and probably the primitive type of ceroris is one that consists of a single opening and in which the periphery is flush with the ectal surface of the cuticle. Such cerores are present in the Coccinae and Eriococcinae. The great majority of the cerores in the Ortheziinae are at the ends of seta-like prolongations of the cuticle. This cuticular extension, which lacks a calyx, has its opening in the free end and is a pilaceroris. One of the commonest types of ceroris is where there are six openings arranged in a circle around the periphery of a central circular area. These are known as paracerores. The cerores located in the rectum, the anacerores, are also known as rectal wax pores, rectal spinnerets, or honey dew glands. The powdery wax in most species of *Pseudococcus* is poured out through cerores that are triangular in outline, the tricerores, and contain numerous irregularly arranged pores. In the Asterolecaniinae the cerores are arranged in pairs with their adjacent margins usually flattened so that they form a figure 8. These are the octacerores. The opening or openings of each ceroris through which the wax is poured is an oraceroris.

In the Diaspidinae the openings through which the wax is poured are generally designated as wax pores or spinnerets. These openings are the external outlets of invaginated cuticular tubes and are not homologous with the cerores. The tubes are known as ceratubae and their external openings as oraceratubae. The ceratubae are not confined to the Diaspidinae, but have been observed in species of Lecaniinae, Kermesiinae, Eriococcinae, and Asterolecaniinae. They will probably be found in some of the other subfamilies. So far as observed, the ceratubae of each subfamily are distinctive in form. They are difficult to observe in unstained specimens.

**Segmentation.**—The cuticle is divided by transverse constrictions, coriae, into three well marked regions, the head, the thorax, and the abdomen. The segmentation of the head is lost during embryonic development, but the three segments of the thorax and the eight or more segments of the abdomen can usually be

identified, particularly in the early nymphal stages. The constricted part of the cuticle, the coria, is usually flexible and marks the division between adjacent segments. The coriae are named from the segments forming their caudal boundary, as the one cephalad of the prothorax is the procoria, the one cephalad of the mesothorax is the mesocoria, the one cephalad of the first abdominal segment is the unacoria, etc.

The segmentation of the body of the adult coccid is greatly obscured through the obliteration of the coriae by the expansion of the body to hold the ovaries or because of its covering of wax or probably in most cases to both of these causes. In the first nymphal stage of certain species the segments and coriae can generally be identified, but they gradually disappear with each successive molt. The microthorax can not be identified and the microcoria, microthorax, and procoria are represented by a single continuous transverse area, which is separated from the head by an infolded area which has been designated the procoria. Where the thoracic coriae are wanting, the thoracic region can be identified from the attachment of the legs when these are present. But where the coriae are obscure or wanting and the legs are wanting, the extent of the thoracic segments can be approximated only by the attachment of the mouth-parts and the location of the thoracic spiracles, the mesospiracles and the metaspiracles.

**Head.**—The head is an area of considerable extent on both dorsal and ventral aspects. It typically bears a pair of antennae, a pair of simple eyes, a rostrum or labium, and a pair of bristle-like mandibles, and a pair of bristle-like maxillae. These are usually all present in the first nymphal stage even though all or a part of them are wanting in all the later nymphal stages and the adult. The caudal extent of the head is marked by the procoria, but this is wanting in many adults, as Diaspidinae and Lecaniinae, where the head and three thoracic segments form a continuous undivided area. This fused area is designated by some writers as the cephalothorax. Something as to the size and shape of the head can frequently be determined from the appendages which it bears and their attachment. The head is generally figured and described as being triangular in outline and limited for the most part to the ventral aspect. Its true size and shape are more easily determined in nymphs of the first stage. The subtriangular ventral area frequently described as the head is only a part of it and represents the fused front and elypeus. It is designated as the frons in the Homoptera and this name should be used here.

The labrum so far as observed is always obsolete. The cephalic portion of the ventral aspect of the head bears the eyes and the antennae and the caudal portion the mouth-parts. The latter are attached between the first pair of legs and usually in line with the first pair of spiracles.

**Eyes.**—The eyes, when present in the female, are always simple. They are comparatively large in the active species and sometimes, as in *Orthezia*, are placed on short projections. The portion representing the eye can usually be recognized even in treated specimens from the presence of pigment. The eyes of the female are sometimes designated as the primary eyes, because they persist through out all the nymphal stages and are present in the adult. The eyes of the male are compound in the *Monophlebinae*, the *Xylococcinae*, the *Margarodinae*, and the *Ortheziinae*. The external part of each separate compound eye, a facet, is strongly convex so that the compound eye appears as a whole coarsely granular. In the subfamilies with compound eyes certain species are also provided with two simple eyes or true ocelli, which are sometimes located between the compound eyes but more often adjacent to their caudal margin. In the other subfamilies the compound eyes are represented by groups of simple eyes which are arranged in a semicircle on each side of the head. The number of simple eyes varies greatly in the different genera. They are most numerous in the *Phenacoleachiinae*, eight on each side, where they form almost a complete circle, but the usual number is from three to five on each side. There is usually a pair of large facets on the dorsal and another on the ventral aspect. It has been claimed by some that the ventral pair of facets is developed from the mouth-parts which are always stated to be wanting. In the wingless males the eyes are limited to two facets, one on each side of the head as in the female, but there is no reason other than similarity in position for considering them homologous with the primary eyes of the female.

Each of the simple eyes of the nymphal and adult female and of the first nymphal male and of the adult male with simple eyes is known as an ocellana. This term is applied to all the simple eyes, other than ocelli, of all *Exometabola*. In order to distinguish the simple eyes other than ocelli of other insects, those found in nymphal and adult *Apterygota* are known as ocellalae and those of the larvae of *Entometabola* as ocellaræ. The position of one pair of ocellanae on the dorsal aspect of the head of certain males, which are not in line with the other ocellanae, would suggest that

they are probably true ocelli. In the Diaspidinae there are three pairs of ocellanae, a pair of large dorsal and a pair of large ventral ocellanae and a pair of minute subdorsal ocellanae. These latter are designated as eyes by Newstead and the large ocellanae as ocelli while in *Lichtensia*, where there are five pairs of ocellanae, two pairs of ventral ocellanae, two pairs of dorsal ocellanae, and a pair of lateral ocellanae, the latter are considered as eyes and all the other ocellanae as ocelli. True ocelli are never present in immature insects of this order and when present in adults are never more than three in number. A very different nomenclature is used by Signoret for the ocellanae. There is no reason for considering any of the pairs of ocellanae as eyes or the homologues of primary eyes. The pair of small ocellanae in the Diaspidinae and one pair in other male coccids may prove to be homologous with the true ocelli of other insects.

**Antennae.**—The antennae are long and prominent in the active species and usually consist of about eleven segments. This number is greatly reduced in the inactive species where the antennae may be wanting. In the Diaspidinae each antenna is generally represented by a minute tubercle bearing from one to four long setae. Where the antennae are large, the distal segment is usually much larger than the others and is sometimes thickened or clavate and irregularly indented or notched. The notches cause this segment to appear as if subdivided or composed of several subsegments. These have been described by some writers as true segments. The indentations mark the location of the attachment of setae. The comparative length of the various segments of the antennae, particularly in the Eriococcinae and Lecaniinae, have been used extensively for the separation of genera and species. The variation in the length of the different segments is usually expressed in the form of a formula, thus: (3, 4), 7, 2, (1, 6). The numbers are the numbers of the segments, the longest segment is always indicated at the left end of the formula and the successively shorter ones are arranged in order from left to right while those of the same length are enclosed in a parenthesis. A formula giving the actual length in microns is used by some authors. Kellogg and Bell have shown from an examination of several individuals from the same colony that there may be enough variation between the segments of the two antennae of the same individual to place them in different genera. This was confirmed by Thro from a study of certain species of Lecaniinae. The number and arrangement of the setae borne by the antennal

segments has been much used by systematists. Careful studies of representative species of several genera of Lecaniinae by Thro showed that the setae were practically identical in number and arrangement in the species studied and the differences described were due to overlooking the calices of setae that had been broken off. In certain genera there is a group or transverse row of setae located on the ventral aspect of the head between the articulations of the antennae which have been named by Green the interantennal setae.

**Rostrum.**—The rostrum in the heteropterous Hemiptera has been shown to be homologous with the labium of other insects. That the rostrum in the Coccidae is homologous with the rostrum of the Heteroptera and the labium of other insects, there is absolutely no doubt. It is an elongate projection attached between the prothoracic legs. The lateral margins of the rostrum are normally folded so that it is U-shaped in cross-section except that the margins meet on the dorso-meson. By this folding a closed furrow is formed, the rostral furrow, which extends lengthwise through the rostrum and serves for holding, guiding, and supporting the bristle-like mandibles and maxillae. The rostrum consists of three segments in *Coelostoma* and *Phenacoleachia*; of two segments in *Icerya*, *Pseudococcus*, and many other coccids; and of a single segment in the Lecaniinae and Diaspidinae. In the adults of the Margarodinae, Xylococcinae, Callipappinae, and Kuwaninae the rostrum is always wanting. It is usually stated that the rostrum is lost in the male at the first or second molt and is wanting in all subsequent stages, including the adult. But in the adults of certain species as those of the genus *Pseudococcus*, it is represented by a minute conical projection. The distal end of the rostrum is frequently provided with large setae, the labial setae. In the Coccidae the rostrum is always much shorter than in the closely related families, the plant lice and the psyllids, rarely if ever extending beyond the thorax and usually only to the caudal margin of the mesothorax.

**Mandibles, Maxillae.**—The mandibles and maxillae are long and bristle-like as in all other Hemiptera. It is very difficult, if not impossible in most cases, to distinguish the mandibles from the maxillae, except where their articulation to the head can be determined. They can be distinguished in some heteropterous Hemiptera by the teeth or projections on their distal ends. The margins of the mandibles and maxillae are furrowed in such a way that they are normally so closely fastened together that it is



difficult to separate them. When they are separated, which sometimes happens from the handling of the specimen, there is frequently apparently less than four parts present, the actual number. The usual number is apparently three. The mandibles in such cases are separated from each other and from the maxillae. They form two of the three parts and the closely applied maxillae the third. They are normally all fastened together and form a tube through which the liquid food is drawn into the pharynx. This structure, formed of the closely applied mandibles and maxillae, is the rostralis. It is frequently longer than the entire body and may be five times as long. The rostrum serves simply as a support for the rostralis and does not function as a tube through which the food is drawn. The free end of the rostralis in individuals which are not attached to their host-plant usually does not project beyond the free end of the rostrum. The mandibles and maxillae are lost at the first or second molt and are wanting in the adult male.

**Crumena.**—The thin cuticle of the head adjacent to the proximal portion of the rostrum is deeply infolded or invaginated, forming a long slender pocket which lies free in the body cavity and generally extends through the mesothorax and metathorax. The rostralis after its exit from the mouth extends into this pocket. This pocket was first described by Mark and by him named the *crumena*. It was later figured and described by Berlese who designated it the *guaina delle setole rostrali*. I had before the name of Mark was discovered designated it as the *theca*. All the slack of the rostralis is held in the *crumena* and the proximal part of the rostral furrow is thickened and forms a sort of bumper, the *plena*, against which the end of the rostralis rests. The *crumena* has been observed in many coccids and is probably present in all. It is difficult to identify in unstained specimens. The rostral fold described by many systematists is the portion of the rostralis retained within the *crumena*.

**Endoskeleton.**—There is a well developed series of chitinated arms or bars present within the cavity of the head of all coccids. These bars are a part of the endoskeleton and are usually designated as the head skeleton or chitinous cradle. The parts of the endoskeleton serve for the attachment of the muscles that operate the rostralis, rostrum, and the parts associated with them. In the differentiation of species or genera, the parts of the endoskeleton have not been used. There is only a slight variation in the form and arrangement of these parts in the different subfamilies.

**Thorax.**—The thorax is divisible into three clearly marked regions in most insects, the prothorax, the mesothorax, and the metathorax. Such a condition does not exist among coccids. The prothorax is usually continuous with the head, except in some nymphs of the first stage, and with difficulty separated from it. The mesocoria and metacoria, the membranes connecting the prothorax and mesothorax and the mesothorax and metathorax, are usually limited to the dorsal and lateral aspects and then only marked as slight transverse constrictions. These coriae are effaced without passing through a suture stage. The combined head and thorax, as in the adult female of the Diaspidinae, are sometimes designated as a cephalothorax.

There is a strongly chitinized area extends dorsad and laterad from the lateral margin of the proximal segment of each leg, a coxa, in certain of the leg bearing species. This linear area has been designated the episternum because it bears a projection for the articulation of a coxa. This articular surface of each episternum is a coxacoila and the articular surface of the coxa which is applied against the coxacoila is a coxartus. In those Hemiptera where the pleural sclerites can be identified, the episternum is usually large and forms the greater part of each pleural area, while the epimeron is small and inconspicuous and forms a narrow area along the caudal margin of the episternum or is covered by it. The coxacoila is typically formed from the episternum and epimeron not only in the Hemiptera but in most insects, so that this area in the Coccidae undoubtedly contains a small portion of each of these sclerites. For the sake of brevity, however, each of the entire areas bearing a coxacoila has been called an episternum. This sclerite is distinct in *Icerya*.

Those species of coccids provided with an episternum are also usually provided with an apodema. This is the thin, vertical, cuticular plate extending into the body cavity from the inner surface of each episternum. These pleural plates form a part of the endoskeleton of the thorax, which is present in most insects, but wanting in all legless coccids. This structure has no relation to the notal area of the male, the mesoscutellum, to which the name of apodema has been incorrectly applied. There is on each side of the meson of the ventral aspect of each thoracic segment of most insects a small invaginated lobe, a furca. The furcae also constitute a part of the endoskeleton of the thorax. In the coccids the furcae are present only in the generalized species and then are represented only by small finger-like projections which are difficult

to identify even in stained mounted specimens. The mesofureae and metafureae are present in *Icerya*. The fureellae another series of invaginated lobes forming a part of the endoskeleton of the ventral aspect have not been identified. Each of the lobes of the endoskeleton, apodemae or fureae, which are primitive structures, is often designated as an apodeme; while other lobes which are identical in form and structure but are secondary in origin are known as parademes.

**Legs.**—The legs are of the ordinary type and sequence of parts of other insects. They appear much larger and longer in the nymph of most species than in the adult because of the size of the body. The profemur is greatly enlarged and dilated in the *Margarodinae* and the protibia is fitted with a hook-like tarsus for digging.

The proximal segment of each leg, a coxa, is subglobular and its proximal end is usually provided with a thickened rim. The middle of the lateral margin of this rim or ring is provided with an articular surface, an artis or coxartis, which articulates with a coxaeoila. The second segment or trochanter is oval or triangular in outline. The largest sclerite or segment of the leg is the third segment or femur. It is usually more or less compressed. The suture between the femur and the trochanter is obsolete in certain species of *Orthezia*. The fourth segment, the tibia, is usually longer than the femur but smaller in diameter. The fifth segment is the tarsus. Its distal end frequently bears long slender clavate setae, which are known as tenant hairs, digitules, or empodial hairs. They are probably the outlets of glands secreting a sticky substance which aids them in clinging to smooth surfaces. The digitules are more frequently present in the males than in the females. The suture between the tibia and tarsus is always wanting in species of *Conchaspis* and in certain species of *Orthezia*. The tarsus consists of a single segment except the protarsus of the males of *Coccus* and all the tarsi of the females of *Exaeretopus*, which have two. The hook borne by each tarsus, a claw, is usually not prominent and in some species bears digitules. The digitules of the legs are distinguished as the tibial digitules and the ungual digitules.

The comparative length of the various segments of the leg is frequently indicated by systematists and used in the separation of species. This is usually stated in microns in a formula, as follows: c. 120-140; tr. 68; fem. 180-240; tib. 120-152; tar. 80-88; claw 12-12.

**Abdomen.**—The third, largest, and most important region of the body is the abdomen. It is of importance because it contains the organs of reproduction and their external opening and the greater part of the structures that excrete the wax for covering the body and the eggs. The abdomen consists typically of ten segments. In the Diaspidinae the segments of the caudal half are fused and the coriae are wanting. Systematists have made no use of the number of abdominal segments and usually those who have described and figured the abdomen have not always been consistent in giving the same number for the same species. The dorsal aspect of each segment is known as a tergum and the ventral aspect as a sternum.

The abdomen in the Diaspidinae is divided into two regions. The cephalic portion consists of four segments with distinct flexible coriae, the preabdomen, and a strongly chitinized caudal portion without coriae, the pygidium. The adult females of the Conchaspinae are described as having a pygidium, but the coriae can be identified between practically all of the segments and they are provided with cerores instead of ceratubae as in the Diaspidinae. In the abdomen of the adult Lecaniinae all the segments are fused and the coriae obsolete, but the coriae can frequently be identified in the nymphal stages, particularly the first.

The segmentation of the body can be determined or approximated in many species of coccids even if the legs are wanting and the intersegmental coriae are obsolete. This can be accomplished by means of the row of setae, cerores, or setae and cerores placed along each lateral margin or around the periphery of the body. The setae of these rows are generally larger or different in form from the other setae of the body so that they can be readily recognized and their intersegmental homology determined. In the first stage nymphs of *Icerya* these structures are large setae placed on prominent chazalae while in *Pseudococcus* they are groups of short conical setae, usually one to six, surrounded by the tricerores which form the prominent pencils of wax projecting from the periphery of the body in all the nymphal stages and the adult. While there is some variation among the different species and genera as to the number and nature of these groups, they are always constant for a given species. The usual arrangement is a single group on each side of each abdominal segment, two to three groups on each side of each thoracic segment, and four to six groups on each half of the head. The components of the cephalic

group of the head and the caudal group of the abdomen are generally subadjacent.

**Anus.**—The external opening of the caudal end of the alimentary canal, the anus, is normally located in the tenth segment. In the Diaspidinae the caudal portion of the abdomen is strongly depressed and the anus is usually a circular opening located on the dorsal aspect. It varies considerable in position, in some species it is located near the cephalic portion of the strongly chitinated pygidium, in others near the caudal end, and in still others it is intermediate in position between these two. In the Lecaniinae and Asterolecaniinae the anus is located at the cephalic end of the invaginated barrel-shaped anal tube. It is usually surrounded by an anal ring at this point and is not located on the exterior of the body as might be expected.

**Vulva.**—The external opening of the female reproductive organs is the vulva. It is located on the ventral aspect generally near the caudal margin of the sixth segment. There are frequently accessory structures associated with it which make its location more easily identified. Figures of the caudal portion of the dorsal or ventral aspects of the abdomen of coccids generally show the position of both anus and vulva on the same drawing, this does not mean that they are both situated on the same aspect. In the Diaspidinae the vulva is usually located near the middle of the pygidium.

**Spiracles.**—The external openings of the respiratory system, the spiracles, also known as stigmata, are usually distinct and are always four in number. The cephalic pair, the mesopiracles, belong to the mesothorax and the caudal pair, the metaspiracles, to the metathorax. These spiracles are normally located in the mesocoria and metacoria. In the leg bearing species, the mesopiracles are located about midway between the articulations of the prothoracic and mesothoracic legs and the metaspiracles about midway between those of the mesothoracic and metathoracic legs. In the Diaspidinae the adults of which are always legless, the mesothoracic spiracles are located one on each side of the rostrum, sometimes designated as the head spiracles, near where the prothoracic legs are ordinarily articulated. The metaspiracles are apparently not different in location from that of the species with legs. The spiracles are the only landmarks available in many legless coccids for indicating the thoracic segmentation. They are greatly reduced in size in the genus *Xylococcus* and were

described by Pergande as wanting, while in *Tachardia* the mesospiracles leave their normal position during nymphal development and through a readjustment of the bag-like body assume a position near the anus.

**Peritreme.**—The spiracles of most insects are surrounded by a thickened area of cuticle which forms a rim about the opening and is known as a peritreme. This rim varies somewhat in form, but in most coccids is simply a circular plate or may be wanting. The portions of the peritreme bordering the two sides of the opening or slit, the cephalic and the caudal, may be modified into lips or labiae for closing the spiracle.

**Spiracularia.**—The prominent parademe extending from the ental surface of the peritreme into the body cavity in certain coccids may be known as the spiracularia. They are distinct in *Leerya* and *Monophlebus*, serve for the attachment of museles, and are so far as known peculiar to the thoracic spiracles.

**Cavaera.**—The tracheal tube connecting with each spiracle, a spiracular trachea, is frequently expanded in the coccids into a chamber of varying size and shape. This chamber is usually trumpet-shaped or globular and its walls are generally smooth, not transversely striate like the ordinary tracheal tube. This structure may be known as the cavaera. It is also known as the collar chamber. The cavaera constitutes the greater part of the structure usually described and figured by students of coccids as a spiracle. This is particularly true of species of *Lecaniinae*. The term spiracle is limited here as with other insects simply to the opening. There are folds sometimes present in the cavaera which serve for closing the spiracle, these should not be confused with the labiae which are modifications of the peritreme.

**Abdominal Spiracles.**—The abdominal spiracles are generally smaller than those of the thorax and may be provided with or lack a distinct peritreme. The normal number of abdominal spiracles for insects in general is eight pairs, a pair on each of the first eight abdominal segments. When less than this number is present, it is due to the reduction or fusion of the first abdominal segment with the adjacent segment and the loss of its spiracles or the atrophy of the spiracles or their loss through the increase in size and the encroachment of the metathorax or the atrophy of the spiracles at the caudal end of the abdomen. Since the abdomen is not used extensively in classification, it is not strange that the number of records of the presence of abdominal spiracles in coccids is not large. They have been recorded more frequently from

among the generalized subfamilies, particularly the *Monophlebinac*, than from the specialized subfamilies. Eight pairs are recorded as present in species of *Stigmaeococcus*, seven in *Perissopneumon*, *Monophlebus*, and *Droschia*, and two or three in *Icerya* on segments six to eight or seven to eight. Abdominal spiracles are also reported as present in *Cryptokermes*, *Margarodes*, and on the first segment of *Conchaspis*. All the species of *Orthézia* examined have seven pairs and there are eight pairs in all the American species of *Xylococcus*. Abdominal spiracles are also present in certain species of *Steingelia*, *Stomatacoccus*, *Coelostomidea*, and *Kuwania*. Cavaerae are rarely if ever associated with the abdominal spiracles.

**Anal Ring.**—The anus in certain genera is surrounded by an elevated ring-like structure, known as the anal ring. It was formerly known as the genital ring or genito-anal ring from the mistaken notion that it surrounded the vulva. The anal ring generally bears a number of setae, typically six, which are longer and stouter than the other setae of the body. There are cereres which vary in form and position in the different genera and species which are arranged irregularly or in rows between the setae. The wax excreted by the anal ring is generally different in character from that excreted by the cereres on other parts of the body and frequently forms a tube through which the honey-dew or excrement is passed. The prominent anal wax-tube formed by species of *Xylococcus* is not excreted in this way but by anaccereres. The anal ring is usually wanting in the adults of the *Kermesiinae* but present in a rudimentary condition in the nymphs.

**Anal Ring Setae.**—The setae borne by the anal ring are known as the anal ring spines, the anal ring hairs, or the anal ring setae. They are usually six in number. There may be as few as two and as many as eight, ten, twelve, or even thirty. Newstead reported twenty to twenty-four in *Aclerda*, but Green does not consider these as anal ring setae. Some authors have recorded a large number of anal ring setae as present in certain genera of *Lecaniinae*, but these are according to Green longitudinal corrugations of the eversible sac of the rectum, the anal tube.

**Anal Lobes.**—Most coccids with an anal ring are also provided with anal lobes. These are the shoulder-like projections or lobes located at the caudal end of the abdomen on each side of the anal ring. They may be present in the nymphal stages and wanting in the adult, in fact they are usually larger and more prominent in the nymphal stages. They vary greatly in form and size. In some species they are so large that the caudal end of the abdomen

appears cleft or emarginate. Each anal lobe bears one or more large setae, the anal setae. These setae probably serve as a core to support the wax filaments excreted by the cerores of the anal lobes.

The presence of an anal ring with anal ring setae and of anal lobes with anal setae seems to be closely correlated. The modification of these structures shows them to be much older in their development than the pygidium of the Diaspidinae which is typically perfect only in the adult female. The anal ring and anal lobes, if present in any stage, are more likely to be found in the first nymphal stage and, if atrophy or modification of parts has begun to take place, it starts with the adult and finally extends into the older nymphal stages. Such changes may be confined to the adult alone. The typical number of anal ring setae is six in the first nymphal stage, although there may be more or less in the other nymphal stages and the adult. A large number of the species lacking an anal ring and anal ring setae in the adult have six anal ring setae in the first nymphal stage. The modification of these structures may extend into the first nymphal stage which is shown in the reduction in the size of the anal ring setae and later in the number of these setae to four, two, or none, and going hand in hand with this change is a segmentation of the anal ring and finally the complete loss of the anal ring itself. There is generally a change in the form and a reduction in the size of the anal lobes associated with the modification of the anal ring, but the anal lobes like the anal ring reach their most perfect development in the first nymphal stage. Some of the subfamilies, as the Diaspidinae, which have evidently been derived from the line with anal lobes, an anal ring, and anal ring setae, in the first nymphal stage of many species have the anal lobes either obscure or so they can be traced, but are always provided with two large prominent anal setae. The position and form of these setae show unquestionably their homology. They are peculiar to the first nymphal stage.



## CHAPTER IV

### CLASSIFICATION

The early students of the Coccidae were not particularly interested in the describing of new species and new genera, but in discussing the habits of certain common species. This was particularly true of the cochineal insects which were introduced into Spain, Italy, and northern Africa after the discovery of America. Upon these a large number of treatises were based. Signoret after deliberating over all the literature of the family published before 1868, gives a list of the described species. This list contains the names of about two hundred and twenty-eight species. Some of these names have been referred to the synonymy and many others were applied to species that were so poorly described that they have not been identified since. The species were included in thirty-five genera. Some idea of the amount of work and study that has been given to this family in recent years can be obtained from a comparison of the number of species and genera listed by Signoret and those included in the catalogue of Mrs. Fernald published in 1903, thirty-five years later. This list contains 1514 species and 164 genera.

The subdivision of the family into sections, tribes, or sub-families varies considerable with the author. The variation consists not only in the rank assigned the various groups and the distribution of the groups, but in their number and the genera apportioned to them.

The first subdivision of the family worthy of consideration was that of Targioni Tozzetti, '68, where four groups are recognized: Orthezites, Coccites, Lecanites, and Diaspites. Signoret prepared the first comprehensive account of the family, the publication of which was begun in 1868, consists of seventeen parts, and was completed in 1875. In a portion of this work published in 1868 four sections are recognized: Diaspides, Brachyseelides, Lecanides, and Coccides. Targioni Tozzetti in 1869 added another tribe to those which he had previously proposed, Lecanodiaspites, placing it between his Lecanites and Diaspites. Comstock, '81, adopted the sections proposed by Signoret, arranged them in the

same order, but ranked them as subfamilies. The new tribe of Targioni Tozzetti was not recognized and the species that had been referred to this tribe were considered as belonging to one of the other sections or subfamilies. The Orthezites of Targioni Tozzetti were included among the Coccinae of Signoret and Comstock.

W. M. Maskell between the years 1879 and 1897 published many papers dealing with the Coccidae. In "An account of New Zealand scale insects" this author divides the family into four groups, Diaspidinae, Lecanidinae, Hemicoccidinae, and Coccidinae. The first two of these groups are the same as the Diaspinae and Lecaninae of Comstock and the second and third represent the Coccinae of this author and Signoret. The Brachyscelinae of Signoret, the Apiomorphinae of this work, which is peculiar to Australia, was omitted. The group Lecanidinae was subdivided by Maskell into three groups: Lecanodiaspidites of Targioni Tozzetti, Lecanidae, and Lecano-coccidae; the Hemicoccidinae into two groups: Kermetidae and Cryptokermetidae; the Coccidinae into five groups: Acanthococcidae, Dactylopidae, Coccidae, Monophlebidae, and Porphyrophoridae. These names although terminating with the usual suffixes applied to subfamilies and families are specifically designated as groups and subdivisions. If all the groups and subdivisions of this classification are taken into account, this would make eleven divisions of the family Coccidae. In a list of New Zealand species published by the same author in 1895, a similar arrangement is followed. There are six subfamilies recognized: Diaspidinae, Lecaninae, Hemicoccinae, Coccinae, Monophlebinae, and Brachyscelinae. The Lecaninae is subdivided into three sections as in the first classification; the Cryptokermetidae of the Hemicoccinae is omitted; the Monophlebinae of the Coccinae is raised to the rank of a subfamily and the Porphyrophoridae, the Margarodinae of later writers, which does not occur in the Australian region, is omitted; and the Brachyscelinae omitted from the previous list is recognized as a subfamily.

Cockerell, '96, in a "Check-list of the Coccidae" recognized ten subfamilies arranged as follows in an ascending order: Monophlebinae, Porphyrophorinae, Coccinae, Hemicoccinae, Ortheziinae, Asterolecaniinae, Brachyscelinae, Idiococcinae, Lecaniinae, and Diaspinae. The very different order in which the subfamilies are arranged, also the appearance of the Orthezites of Targioni Tozzetti again but as a subfamily and the substitution of the name

Asterolecaniinae for the Lecanodiaspidites of Targioni Tozzetti and the Lecanococcidae of Maskell, is worthy of note.

Berlese and Leonardi, '98, in their "Notizie intorno alle cocciniglie americane che minacciano la frutticoltura europea" recognize eight groups, tribes as they designate them, but with subfamily suffixes, which are arranged in the following order: Monophlebinae, Porphyrophorinae, Coccinae, Hemicoccinae, Ortheziinae, Asterolecaniinae, Lecaninae, and Diaspinae. In a table for the separation of the subfamilies two additional tribes, Brachyseelinae placed between the Lecaninae and Coccinae and Idiococcinae placed before the Monophlebinae, are recognized. This arrangement does not differ from that of Cockerell. The five subgroups of their tribe Diaspinae which are recognized by Leonardi in his "Generi e specie di Diaspiti," the first part of which was printed early in 1898, are adopted in the "Notizie" and arranged in the same order: Parlatoriae, Aspidioti, Leucaspides, Diaspides, and Mytilaspides.

Green, '96, in the first volume of his "Coccidae of Ceylon" proposes eleven subfamilies arranged as follows in an ascending order: Conchaspinae, Diaspinae, Lecaniinae, Hemicoccinae, Dactylopiinae, Tachardiinae, Coccinae, Idiococcinae, Brachyseelinae, Ortheziinae, and Monophlebinae. In remarking upon the classification of Cockerell, he states, "I should be inclined to include the Porphyrophorinae with the Monophlebinae . . . nor does the separation of the Asterolecaniinae from the Coccinae (as generally constituted) seem necessary." In volume four of this work, published in 1909, Green, however, adopts the subfamily Asterolecaniinae and places it between the Dactylopiinae and Tachardiinae. This is the first recognition of a subfamily Tachardiinae which includes the genus *Tachardia*, the lac insects. The name of Conchaspis also appears in this list of subfamilies for the first time, erected to include the genus *Conchaspis* described in 1893. It is here associated by Green with his subfamily Diaspinae.

In a series of tables for the identification of genera, Cockerell in 1899 shows eight subfamilies arranged in the following order: Ortheziinae, Monophlebinae, Margarodinae, Conchaspinae, Coccinae, Tachardiinae, Lecaniinae, and (Diaspinae). The name *Margarodinae* is substituted for Porphyrophorinae and the subfamily divided into two tribes, Margarodini and Xylococcini. The subfamily Coccinae includes five tribes: Brachyseelini, Asterolecaniini, Kermesiini, Eriococcini, and Dactylopiini. It will be noted that

the arrangement of the subfamilies is quite different from that proposed in 1896. The subfamily *Conchaspinae*, which did not appear in the previous list, is placed between the *Margarodinae* and the *Coccinae*. Four of the subfamilies of the previous list are distributed among the five tribes of the subfamily *Coccinae*: (1) *Hemiocecinæ* is changed to *Kermesini*, (2) *Asterolecaniinae* to *Asterolecanini*, (3) *Brachyseelinae* to *Brachyseellini*, and (4) *Idiococcinae* is included with the *Eriococcini*. A new tribe, *Dactylopiini*, is added to this subfamily. The subfamily name *Tachardiinae*, to include the lac insects and first used by Green, is adopted here. The arrangement of both of the classifications of Cockerell are evidently intended to show a disposition in an ascending order instead of a descending order as was evidently intended by Signoret, Comstock, and Maskell.

Newstead, '01, in his "*Coccidae of the British Isles*" has "with slight alterations, adopted the very clear and comprehensive divisions recently given by Mr. E. E. Green, adding thereto the subdivision *Margarodinae*, which, from the absence of mouth-parts in the adult female, I agree with Professor Cockerell naturally calls for a separate division. I should also add that Mr. Green places the *Conchaspinae* before the *Diaspinae*; but it seems to me, although I may be quite wrong, that the insects comprising this subfamily are more naturally placed in the ascending order above the *Diaspinae*, and I have therefore made this additional deviation from Mr. Green's classification."

The first complete "*Catalogue of the Coccidae of the World*" was published in 1903 by Mrs. M. E. Fernald. There are nine subfamilies recognized in this work arranged in the following order: *Monophlebinae*, *Margarodinae*, *Ortheziinae*, *Phenacoleachiinae*, *Conchaspinae*, *Dactylopiinae*, *Tachardiinae*, *Coccinae*, and *Diaspinae*. The arrangement of the subfamilies and genera is in an ascending order. The first three subfamilies of this list are similar in extent to the same group of Cockerell, Green, and Newstead. The fourth subfamily, *Phenacoleachiinae*, erected by Cockerell, is for a peculiar species and genus described from New Zealand by Maskell. The position of the *Conchaspinae* is the anomalous one of the classification of Cockerell, near the *Dactylopiinae*. The *Dactylopiinae* includes the *Brachyseelinae*, *Asterolecaniinae*, *Kermesinae*, *Eriococcinae*, *Idiococcinae*, and *Dactylopiinae* of other authors. The type of each genus is indicated. The genus *Coccus*, which had been used by all previous writers for the cochineal

insects with cacti as type, has a species previously referred to the genus *Lecanium*, *hesperidum*, named as its type. From this change there has resulted a suppression of the generic name *Lecanium* and of the subfamily name *Lecaniinae* derived from it. For these the generic name *Coccus* and the subfamily name *Coccinae* are substituted. The cochineal insects are referred by Mrs. Fernald to the genus *Dactylopius* and to the subfamily *Dactylopiinae*. I have examined the evidence submitted but have been unable to discover any basis for the change and the original application of these generic names, *Coccus* and *Lecanium*, has been restored in the following pages. The *Tachardiinae* and *Diaspinae* are of the same extent as these groups of Green and Cockerell. A reduction in the number of subfamilies has resulted in the combination of unrelated groups and marked a backward rather than a forward step in the classification of the family. This is more than offset by the way in which this catalogue has made the literature of the family available to the various students of the group. The United States Bureau of Entomology has issued five supplements, but these include only the names of new genera and species, the place where they were described, the localities, and the host-plants. The same arrangement of subfamilies is followed. The classification adopted by Mrs. Fernald was evidently under the sponsorship of Cockerell as the following from the introduction implies. "It gives me much pleasure to acknowledge numerous favors and great assistance received in the preparation of this work. . . . Especially am I indebted to Prof. T. D. A. Cockerell, who for the past two years has been constantly sending me *separata* and references to foreign literature, besides giving me all possible assistance in regard to classification and synonymy, the result of his extensive studies on the Coccidae from all parts of the world. To him is due much of whatever value there may be in this catalogue."

A linear arrangement such as must be used on a printed page is not feasible for showing the phylogeny of a group of animals or plants. This should be kept in mind when examining and judging all of the preceding classifications. The family Coccidae has been divided into seventeen subfamilies on the following pages. These have been arranged in an ascending order. The following arrangement of the dichotomous groups is an attempt to show graphically by means of a table something as to the lines of modification of these groups and is not a statement of characters to be used for the identification of specimens. The synopsis shows

what I believe to be the relation of these subfamilies and the scientific and vernacular names that have been applied to them.

### SYNOPSIS OF THE COCCIDAE

#### GENERALIZED COCCIDAE.—Anal Lobes and Anal Ring Undeveloped.

##### Males with Compound Eyes.

Rostralis Conservers. 1. The Giant Coccids.—MONOPHEBINAE.

##### Rostralis Loosers.

##### Abdominal Spiracle Conservers.

Prothoracic Legs Normal in Form.

Spiracles closed, Spiracular Tracheae without Cerores

2. The Sinoran Coccids.—KUWANIINAE.

Spiracles Open and Spiracular Tracheae with Cerores.

3. The Meltratuban Coccids.—XYLOCOCCINAE.

##### Prothoracic Legs Fossorial.

4. The Ground Pearls.—MARGARODINAE.

##### Abdominal Spiracles Loosers.

5. The Marsupial Coccids.—CALLAPAPPINAE.

##### Males with Simple Eyes. 6. The Cochineal Coccids.—COCCINAE.

#### SPECIALIZED COCCIDS—Anal Lobes and Anal Ring Developed.

##### Abdomen of Anal Ring Type.

##### Anal Lobe Lackers.

Males with Compound Eyes.

7. The Ensign Coccids.—ORTHEZIINAE.

Males with Simple Eyes.

8. The Ringeyed Coccids.—PIENACOLEACHINAE.

##### Anal Lobe Possessors.

##### Anal Ring Conservers.

Thorax typically with Cerari.

9. The Mealy Bugs.—ERIOCOCCINAE.

Thorax with Canellae.

Abdomen with Rectal and Stigmatal Processes.

10. The Lac Insects.—TACHARDIINAE.

Abdomen with an Anal Cleft.

11. The Tortoise Scales.—LECANIINAE.

##### Anal Ring Loosers.

##### Nymphs Anal Ring Conservers.

Abdomen short, subequal to Head and Thorax.

Adult Female with Cerores, Body Naked.

12. The Pseudogall Coccids.—KERMESINAE.

Adult Female with Octacerores, Body Covered.

13. The Ceravitreus Coccids.—ASTEROLECANIINAE.

Abdomen longer than Head and Thorax, Top-shaped.

14. The Pegtop Coccids.—APHOMORPHINAE.

##### Nymphs Anal Ring Loosers.

15. The Lubberly Coccids.—CYLINDROCOCCINAE.

##### Abdomen of Pygidial Type.

##### Abdomen with Cerores.

16. The Exuvialess Coccids.—CONCHASPINAE.

Abdomen with Ceratubae. 17. The Armored Scales.—DIASPIDINAE.

The coccids in common with all other groups of animals are divisible into two series, a generalized series and a specialized series. These two series are differentiated so far as the Coccidae are concerned by the lack or development of anal lobes and an anal ring, three structures that are closely correlated. The presence of either anal lobes or of an anal ring in one or all the stages of any given species of all but the generalized end of the specialized series although the other, anal lobes or anal ring, is wanting, is considered as indicative of the presence of both anal lobes and an anal ring in the progenitors of the species.

The generalized series, The Generalized Coccids, includes those subfamilies in which an anal ring and anal lobes are not only wanting but the members of this series were separated off from the progenitors of the coccids before the origin of these structures. The subfamilies of this series, six in number, represent very different types. The long many segmented antennae, the many segmented body, the retention of legs, the two or three segmented rostrum, the retention of ten pairs of spiracles in certain genera, the presence of furcae and apodemae and episterna, and the retention of compound eyes and usually ocelli in the adult male, all mark the Monophlebiniae as the most generalized member not only of this series but of the family Coccidae. The four following subfamilies all agree in that the adult females lack a rostralis and probably a rostrum and that the adult males have compound eyes, usually also with ocelli. Each subfamily bears the brand of a different line of development, the Kuwaniinae contains the most generalized species, those which are only slightly different from the Monophlebiniae, many of them apparently differ only in the loss of their rostralis. The Xylococcinae, Margarodinae, and Callapappinae have each gone along a tangent of its own. In the first the nymphs of the species live in depressions in the solid bark of trees and there has been developed a structure in the rectum for excreting a long thread-like anal tube of wax through which the excreta is passed. The presence of a similar structure in the nymphs of certain Monophlebiniae is of interest. In the second subfamily, the loss of legs during certain nymphal stages and the enclosure of the body in a pearly cyst is distinctive. The legs are regained at the last molt. The presence of greatly enlarged prothoracic legs which are fitted for digging, since all the species live upon the roots of plants, in both males and females is not only characteristic but distinctive. In the third subfamily the

large size of the individuals and the invagination of the abdomen in the adult female to form a pouch for carrying the eggs so that there are only two or at most three abdominal segments exposed is characteristic. The presence of the anus and vulva at the cephalic end of the pouch and the apparent absence of most of the abdominal spiracles is to be expected.

The subfamily Coccinae includes the most specialized species of the Generalized Coccids. They differ from the four subfamilies just described in the retention of the rostralis. In this feature they agree with the Monophlebinae, from which they are not readily differentiated. The most striking features are the few segmented antennae, the absence of abdominal spiracles, the presence of short blunt truncated setae, and the presence of ocellanae in the adult male instead of compound eyes. This last feature separates them from the five other subfamilies. The absence of anal lobes and an anal ring not only in all nymphal stages but in the adult female together with the characteristic form of the abdomen precludes the association of the subfamily with the Specialized Coccids. The presence of ocellanae in the adult male and the absence of abdominal spiracles in all stages of the female would necessitate the association of the group, if placed with the Specialized Coccids, with the most specialized members of this series. The structure of the species of the Coccinae makes this impossible.

As is common with other groups, the second series, the Specialized Coccids, includes not only the largest groups, but those showing the greatest departure from the form and structure found in the Monophlebinae. This series is divisible into two marked types, the Anal Ring Type and the Pygidial Type. The anal ring is evidently older phylogenetically than the anal lobes, because in the two subfamilies, Ortheziinae and Phenacoleachiinae, which are recognized as the most generalized of the series, a well developed anal ring is present in both but there is no indication of anal lobes in any stage of any of the species of either group. The retention of compound eyes with ocelli, three at least in one species, in the adult male and of several pairs of abdominal spiracles in the females of many species is strong evidence in corroboration of the consideration of the species of this subfamily as the most generalized of the Specialized Coccids. This is further substantiated by the long many segmented antennae, the distinctly segmented abdomen, and the retention of legs in all stages. The cerores of the Ortheziinae, which are characteristic in form, differentiate them, so far



as these structures are concerned, from all the other subfamilies.

The lack of anal lobes and anal setae in all stages, the presence of a large number of ocellanae forming almost a complete ring about the head in the adult male, the eleven segmented antennae of the adult female, the three segmented rostrum, and the seven segmented antennae of the nymph, which in most nymphal coccids generally consists of only six segments, show the single species belonging to this subfamily, the *Phenacoleachiinae*, as a generalized one. The abdominal spiracles are not mentioned and are assumed to be wanting. These characters show it as a group early separated from the stem of the Specialized Coccids and, while associated in the synopsis with the *Ortheziinae*, is related to them only by the presence of an anal ring and the lack of anal lobes. This list of characters also shows that the group does not belong with and is not related to those specialized species of *Eriococcinae* which have lost their anal lobes. The body of the female, judging from the description, is evidently provided with cerores grouped to form cerari which excrete lateral pencils of wax, a condition characteristic of many *eriococcids*. The absence or presence of anal lobes and anal setae makes possible the division of the subfamilies assigned to the Anal Ring Type into two groups, the Anal Lobe Lackers, including the *Ortheziinae* and the *Phenacoleachiinae*, and the Anal Lobe Possessors.

The Anal Lobe Possessors consist of two groups, the Anal Ring Conservers, including the *Eriococcinae*, the *Tachardiinae*, and the *Lecaniinae*, in which both anal ring and anal lobes are typically well developed, and the Anal Ring Loosers in which the anal ring is gradually suppressed in the adult or older nymphal stages. Each of the subfamilies of the Anal Ring Conservers represents a distinct independent line of development. The *Eriococcinae* have the body covered with cerores which typically excrete a mealy covering. The cerores may be associated with setae along each lateral margin of the body and with the anal setae, forming cerarae, the marginal mealy pencils of wax. The distinctly segmented body, the prominent segmented antennae, the legs of normal form and size are characteristic. This series of subfamilies as well as the remaining subfamilies except the *Conchaspinae* lack abdominal spiracles, but the thoracic spiracles are distinct and typical in location. The prominence of the anal ring and anal lobes and anal setae in the first nymphal stage of most species are indicative that these structures are characteristic of this group.

The body in the adult female of all the species of Tachardiinae is a bag with the mouth-parts at one end and three tubes at the other. One of the tubes, the mesal one, bears the anus and anal ring and anal ring setae. The mesothoracic spiracles are associated with the other two. These spiracles reach their present position through a revamping of the body. The first stage nymphs are similar in a general way to those of the Eriococcinae, although the anal lobes and the anal setae are wanting, showing that the usual form of the body of the adult female is derived from a progenitor of a type common to that of the Eriococcinae. The lack of cerores in the adult female, although a considerable amount of wax is excreted, the loss of legs, the presence of canellae with cerores, and the loss of antennae mark it as a distinct line of development. The segmentation is distinct in the first nymphal stage, obscure in the others, and wanting in the adult female.

The first nymphal stage in the Lecaniinae, while different when examined in detail, has many of the characteristic features of the first nymphal females of the Eriococcinae. The presence of canellae marks a relationship with the Tachardiinae. The segmentation is generally obscure in the first nymphal stage, but legs and antennae, while wanting in some of the highly specialized genera, are usually present. The presence of the characteristic anal cleft with an operculum on each side near the caudal end of the anal cleft in the first nymphal stage and at its cephalic end in the adult female is characteristic. The development of an eversible tubular extension caudad of the anus and anal ring from an invagination of the body-wall is also distinctive. The three subfamilies of the Anal Ring Conservers have features showing their origin from a common progenitor, but many other structures mark the development of each along a line peculiarly its own.

Each of the four subfamilies of the Anal Ring Loosers, like each of the subfamilies of the Anal Ring Conservers, has developed along characteristic phylogenetic lines. Lines that are so distinctive that they can not be said to have been derived from any one of the subfamilies of the Anal Ring Conservers. While each of these subfamilies retains features showing their relationship with the generalized species of Eriococcinae, these features are confined for the most part to the first nymphal stage and must be interpreted as indicating a common descent with the Eriococcinae instead of an intimate relationship with or descent from this group. While the anal ring and anal ring setae are more ancient structures

than the anal lobes and anal setae, as already noted, the latter are more persistent and are often retained after the complete loss of the anal ring. The anal lobes and anal ring are retained in the nymphs of Kermesiinae, Asterolecaniinae, and Apiomorphinae, they are usually wanting in the adults, while in the *Cylindrococcinae* the anal ring is wanting in all nymphal stages as well as in the adult, but anal lobes are generally retained in the first nymphal stage. The naked globular unsegmented body without or with greatly reduced legs and antennae is characteristic of the Kermesiinae; the vitreous or glassy covering of wax excreted from oetaerores is characteristic of the typical Asterolecaniinae; the greatly elongated top-shaped body with the abdomen typically several times the length of the head and thorax together, fitting the insect for a life in an open gall, is characteristic of the Apiomorphinae; and the peculiar circular mite-like bodies with the legs wanting or one pair much longer and larger than the others is characteristic of the *Cylindrococcinae*.

In the two subfamilies with the pygidial type of abdomen, all trace of the anal ring and anal ring setae are typically lost in all nymphal stages and the adult. Brittin has recently recorded the presence of an anal ring with anal ring setae in *Scutare*, a new genus of Conchaspinae from New Zealand. They differ from all other coccids in having the body covered by a loose thin disk-like scale of wax formed by the weaving together of threads of wax. There are two subfamilies included, the Conchaspinae in which the scale is formed from wax excreted from cerores. The legs and antennae are present in all stages and the first abdominal segment bears a pair of spiracles. The abdomen is depressed and the general form of the body is that of the next subfamily, but there is no fusion of segments to form a pygidium like that of the Diaspidinae. In the second subfamily, the Diaspidinae, the scale is formed from wax excreted from ceratubae. The antennae and legs are present in the first nymphal stage but are wanting in the second nymphal stage and the adult female. The abdomen never bears spiracles but is always depressed and the caudal segments are fused into a prominent pygidium which typically bears numerous microscopic projections of great taxonomic value. The scale differs from that of the Conchaspinae in that there is mixed with the wax of the scale the cast skins or exuviae of the nymph.

The following tables are for the separation of the specimens of the subfamilies listed in the above synopsis. They are artificial in

arrangement and are not intended to indicate anything as to the relationship of the groups concerned. The tables are for three different ages of each species, first, for those of the first nymphal stage which would include males and females since the sexes are indistinguishable in this stage; second, for those of the other nymphal stages of the female, one, two or more as the case may be; and third, for those of the adult female. There has been included in this last table in certain of the subheads such nymphal structures as would make the table more usable, definite, and exclusive. I am aware that the two tables for the separation of nymphs are very inadequate and experience will undoubtedly show that they are defective. They are offered even with their imperfections in hopes that they may at times prove of value and also that the various students of the Coccidae may be led to record observations that will make possible the removal of the imperfections, so that better tables for the separation of the nymphal stages can be constructed. Experience has shown that in many if not all of the subfamilies, there are characters present in the nymphal stages that are not only more easily observed but more fixed than many of the characters found in the adult females.

Tables for the separation of the subfamilies as well as all the later tables follow an exact dichotomous arrangement. While tables of this sort require more space because of the indentation of the paragraphs, this is more than compensated for by the ease with which the rank of the paragraphs can be recognized through the difference in the indentation. The difference in rank is further shown by the numbering of the paragraphs with the letters of the alphabet, the sequence of the letters showing the relative rank of the paragraph. In using the tables the statement of characters given under paragraph a and aa should be read and carefully compared. The specimen should then be examined and compared with the statement of characters given under a and aa and the question decided as to which of these statements describe the characters found in the individual examined. If the specimen agrees with the characterization given under a, the other paragraphs given under a should be examined and all those under aa should be disregarded. Read the characterizations given under b and bb and determine with which of these the specimen agrees. If the specimen agrees with b, disregard the paragraphs under bb and then determine in the same way whether it agrees with c or cc, d or dd, e or ee, etc., or until the name of a subfamily has been reached.

These names are printed at the right-hand end of the last line of certain paragraphs. If the specimen should agree with bb instead of b, disregard the paragraphs under b and then determine in the same way with which of the paragraphs under bb the specimen should agree until the name of a subfamily is reached. If the specimen should belong under aa instead of a, then all of the paragraphs under a should be disregarded and the specimen compared with the characterizations given under b and bb, c and cc, d and dd, etc. of aa until its correct position has been determined.

### SUBFAMILIES OF COCCIDAE

#### FIRST NYMPHIAL STAGE

- a. Abdomen, even if consisting of only six segments, never with caudal end chitinated, depressed, and forming a pygidium bearing two large anal setae.
- b. Abdomen either with or without spiracles, but if with spiracles, never with only a single pair located on the first segment; tibio-tarsal sutures rarely obsolete, if so, body always with pilacerores.
- c. Abdomen never longitudinally cleft at caudal end, forming anal cleft with operculum on each side of cleft, if apparently cleft, body always provided with octacerores.
- d. Abdomen always without anal ring and anal ring setae.
  - e. Abdomen with caudal and lateral margins fringed with chalazae; antennae distinctly clavate.-----*MONOPHLEBINAE*.
  - ee. Abdomen with caudal and lateral margins never fringed with chalazae; antennae rarely clavate, usually not enlarged, but setaceous, or at most only slightly clavate.
  - f. Prothoracic legs greatly enlarged with greatly swollen femora and fitted for digging; first pair of abdominal spiracles dorsal in position, other abdominal spiracles ventral in position. -----*MARGARODINAE*.
  - ff. Prothoracic legs never greatly enlarged with greatly swollen femora and fitted for digging; abdominal spiracles, when present, always with those of first segment on same aspect as those of other segments.
- g. Abdomen never provided with anal lobes and anal setae.
  - h. Abdomen always provided with two or more pairs of spiracles, some of them sometimes small and inconspicuous; cuticle never provided with numerous short truncate setae.
  - i. Abdomen, if with spiracles, always with more than three pairs; rostrum consisting of two segments.
  - j. Thorax with two pairs of spiracles which are large and normal in size; ventro-meson of

caudal portion of abdomen not with a row of large cerores; caudal abdominal segment not projecting farther caudad than lateral portions of penultimate segment; coriae between segments convex. -----KUWANINAE.

- jj. Thorax with two pairs of spiracles which are minute and often inconspicuous; ventromeson of the caudal portion of abdomen with a longitudinal row of large cerores; caudal abdominal segment projecting farther caudad than the lateral portions of penultimate segment; coria between segments straight.-----

XYLOCOCINAE.

- ii. Abdomen never with more than three pairs of spiracles located on segments one to three; rostrum consisting of single segment.-----

CALLIPATTINAE.

- hh. Abdomen without spiracles; cuticle provided with numerous short truncate setae arranged in longitudinal rows; rostrum consisting of two inconspicuous segments. -----COCCINAE.

- gg. Abdomen provided with anal lobes and small anal setae, often obscure; dorsal aspect of body often with prominent longitudinal or transverse rows of setae; rostrum consisting of two segments. -----

CYLINDROCCINAE.

- dd. Abdomen always with anal ring with anal ring setae.

- e. Body always bearing groups of pilacerores excreting lamellae of hard white wax which are usually more or less fused; tibio-tarsal sutures sometimes obsolete; abdomen frequently with seven pairs of spiracles; rostrum consisting of two segments. -----ORTHEZINAE.

- ee. Body never bearing groups of pilacerores; abdomen, so far as known, never provided with spiracles.

- f. Rostrum consisting of three segments; abdomen not provided with anal lobes or anal setae; antennae consisting of seven segments; tarsus with toothed claw.

PHENACOLEACHINAE.

- ff. Rostrum usually consisting of two segments, sometimes of only single segment, never of three segments; abdomen provided with anal lobes and anal setae, sometimes obscure; antennae usually consisting of six segments, sometimes with less.

- g. Thorax always provided with prominent canellae with cerores extending from mesospiracles, metaspiracles without canellae; anal lobes and anal setae wanting; anal ring located at caudal end of body on protuberance, each of six anal ring setae attached to chitinous plate. -----TACHARDINAE.

- gg. Thorax never provided with canellae; anal lobes present, sometimes obscure; anal ring more or less distant from caudal end of body and each anal ring seta never attached to chitinized plate.
- h. Body never provided with octacerores, these generally arranged in longitudinal transverse or marginal rows; rostrum consisting of a single segment.
- hh. Body never provided with octacerores; rostrum, so far as known, always consisting of two segments.
  - i. Body strongly depressed, elliptical or oval, and its periphery fringed with flattened suboval scales; anal lobes obscure or wanting, anal setae large and distinct. -----APIOMORPHINAE.
  - ii. Body rarely depressed, elliptical or oval in outline, usually elongate, and its periphery never fringed with flattened suboval scales; anal lobes and anal setae usually distinct.
  - j. Body almost naked or sparsely setaceous, with setae spine-like and arranged in longitudinal or marginal rows, body often with cerarae; cerores abundant, so that body is usually covered with mealy or powdered wax; ocellana present on each side of head; anal ring complete, rarely divided, length of anal ring setae usually several times width of anal ring. -----ERIOCOCCINAE.
  - jj. Body usually provided with prominent spine-like setae, generally arranged in marginal rows, sometimes in longitudinal rows, never provided with cerarae; cerores never abundant, always a few in number and body at most only rarely covered with mealy or powdery wax; ocellanae wanting; anal ring often subdivided or obscure, anal ring setae generally short, at most not much if any longer than width of anal ring. -----KERMESINAE.
- cc. Abdomen always longitudinally cleft at caudal end and with an operculum on each side near the caudal end of cleft; body not or only rarely provided with octacerores; rostrum consisting of single segment; anal ring situated at cephalic end of lumen of an anal tube and concealed externally unless exerted. -----LECANINAE.
- bb. Abdomen always with single pair of spiracles, always located on first segment; tibio-tarsal sutures always wanting; body never with pilacerores; rostrum consisting of two segments; body with cerores, few in number, never with ceratubae. -----CONCHASPINAE.
- aa. Abdomen consisting apparently of six segments, caudal segment depressed and strongly chitinized, forming a pygidium, bearing two long anal setae, decussating and folded over abdomen; rostrum

consisting of single segment; body with ceratubae, never with cerores; legs and antennae always present, latter consisting of six segments. -----DIASPIDINAE.

## FEMALE NYMPHS

- a. Abdomen never with caudal end strongly chitinized and flattened, forming pygidium, even if flattened, not with pectinae, plates, or ceratubae; legs present or wanting, if wanting, body never covered by leaf-like scale with exuviae.
- b. Legs present or wanting, if present, never with body covered by leaf-like scale without exuviae; tibio-tarsal sutures rarely obsolete, if so, body with numerous pilacerores; abdominal spiracles, if present, not limited to first abdominal segment.
- c. Abdomen not longitudinally cleft at caudal end with operculum on each side of cleft, if apparently cleft, body provided with octacerores.
- d. Abdomen always without anal ring and anal ring setae.
- e. Legs and antennae wanting.
  - f. Abdomen with first pair of spiracles dorsal in position, others ventral; body of insect usually encased in irregular cyst of over-lapping plates, somewhat pine-cone-like; insects living in ground; rectum never chitinized and provided with rings of anacerores excreting long thread-like tube of wax; abdominal spiracular tracheae never with cerores. -----MARGARIDINAE.
  - ff. Abdomen with first pair of spiracles, when present, on same aspect as those of other segments; body of insect never encased in irregular cyst of overlapping plates; insects arboreal in their habits; rectum strongly chitinized and provided with rings of anacerores excreting long thread-like tube of wax; abdominal spiracular tracheae with cerores. -----XYLOCOCINAE.
- ee. Legs and antennae present; rectum never with rings of anacerores, spiracular tracheae never with cerores, or body never encased in irregular cyst of over-lapping plates.
  - f. Abdomen never with any indication of anal lobes and never with anal setae; legs usually present and normal in form.
  - g. Cuticle of body never bearing numerous short truncate setae; abdomen frequently with spiracles.
  - h. Abdomen either without spiracles or if with spiracles, usually with more than three pairs, if with three pairs, located on segments six to eight.
  - i. Abdomen usually with lateral and caudal margins fringed with band of setae, more numerous and longer than those of dorsal or ventral aspects, among which are located large cerores; rostrum consisting of two or three segments.

MONOPHLEBINAE.



- ff. Abdomen, so far as known, not with lateral and caudal margins fringed with setae more numerous or longer than those of dorsal or ventral aspects; rostrum consisting of two segments. -----KWANINAE.
- hh. Abdomen never with more than three pairs of spiracles and these always located on segments one to three; rostrum, if present, consisting of a single segment.-----CALLIPAPPINAE.
- gg. Cuticle of body bearing numerous short truncate setae; abdomen always without spiracles; rostrum never wanting, consisting of two inconspicuous segments. -----COCCINAE.
- ff. Abdomen with anal lobes and small anal setae, anal lobes often inconspicuous, rostrum always present and consisting of two segments. -----CYLINDROCOCCINAE.
- dd. Abdomen always with anal ring and anal ring setae.
- e. Body bearing groups of pilicerores excreting lamellae of white wax which are more or less fused; tibio-tarsal suture sometimes obsolete; abdomen frequently with seven pairs of spiracles.-----ORTHEZIINAE.
- ee. Body never bearing groups of pilicerores; tibio-tarsal suture present; abdomen, so far as known, never provided with spiracles.
- f. Rostrum consisting of three segments; abdomen not with anal lobes or anal setae; tarsus with toothed claw. -----PIENACOLEACHINAE.
- ff. Rostrum usually consisting of two segments, sometimes of only single segment, never of three segments; abdomen usually provided with anal lobes and anal setae, anal lobes sometimes obscure or wanting.
- g. Thorax provided with canellae associated with mesospiracles, extending onto dorsal aspect, mesospiracles twice as far apart measured on sternum as metaspiracles; anal ring setae ten in number and placed on six circular or oval plates; anal lobes and anal setae wanting. -----TACHARDIINAE.
- gg. Thorax never provided with canellae; mesospiracles at most only slightly farther apart on ventral aspect than metaspiracles; anal ring setae never placed on plates, usually six in number, sometimes more or less.
- h. Body provided with octacerores, generally arranged in longitudinal, transverse, or marginal rows; rostrum consisting of single segment.-----ASTEROLECANIINAE.
- hh. Body never provided with octacerores; rostrum, so far as known, always consisting of two segments.

- i. Abdomen elongate, much longer than head and thorax together, lateral margins strongly convergent caudad; anal lobes strongly chitinized, divergent, pointed, and prominent; metathoracic coxae twice as far apart as prothoracic coxae. -----APIOMORPHINAE.
- ii. Abdomen not decidedly elongate, subequal in length to head and thorax together; lateral margins usually not strongly convergent caudad, usually with anal lobes, but these not pointed, divergent, strongly chitinized projections; metathoracic coxae at most only slightly farther apart than prothoracic coxae.
- j. Body bearing numerous cerores excreting powdery or mealy wax, forming covering for the body, cerores often associated with setae and forming cerarae; anal ring usually bearing anal ring setae, setae sometimes small, reduced in number, less than six or wanting, usually similar to or more than in adult.-----  
ERIOCOCCINAE.
- jj. Body practically without or with only few cerores; mealy or powdery wax, if present, limited to the ventral aspect; only first nymphal stage and adult female have been described. -----KERMESINAE.
- cc. Abdomen always longitudinally cleft at caudal end and with an operculum on each side of cleft; cuticle not or only rarely provided with octacerores; rostrum consisting of single segment; anal ring situated at cephalic end of lumen of anal tube and concealed externally unless exerted. -----LECANINAE.
- bb. Legs always present and body always covered with leaf-like scale without exuviae; tibio-tarsal suture always obsolete; body with only few cerores, never with pilacerores; abdominal spiracles limited to single pair on first abdominal segment.-----  
CONCLASPINAE.
- aa. Abdomen with caudal end always strongly chitinized and flattened, forming pygidium fringed with pectinae or plates and bearing ceratubae; legs and antennae always wanting and body always covered by leaf-like scale with exuviae.-----DIASPIDINAE.

## ADULT FEMALES

- a. Abdomen of adult female with all segments separate and flexible or all segments fused and inflexible, but never divided into two regions, cephalic series of four flexible movable segments forming preabdomen and caudal series of fused inflexible segments forming pygidium bearing plates or pectinae; dorsal aspect of abdomen with or without cerores but never with ceratubae.
- b. Legs present or wanting, if present, never with body covered

*with leaf-like scale without exuviae; tibio-tarsal sutures rarely obsolete, if so, body bearing pilacerores.*

- c. Abdomen of adult female never longitudinally cleft at caudal end with pair of opercula at cephalic end of cleft, if apparently cleft and provided with opercula, cuticle usually bearing octacerores in some of nymphal stages and usually also in adult female, frequently provided with cribiform plates if provided with octacerores.
- d. Body of adult female never with mouth-parts at one end and three tubular projections with associated spine-like projection; never enclosed in resinous cell with three adjacent openings; mesothoracic spiracles never associated with stigmatic processes located near anus.
- e. Adult female and female nymphs rarely provided with octacerores, if so provided, also provided with ventral cribiform plates; never with dorsal cribiform plates; rostrum usually consisting of two or three segments, if of only one segment, abdomen invaginated to form a marsupium.
- f. Body of adult female never flask-shaped or peg-top-shaped; abdomen with sides uniformly convex, not strongly convergent caudad, as broad as or broader than thorax at cephalic end and usually as long as or longer than thorax.
- g. Adult female and female nymphs always without anal ring and without anal ring setae; body of adult female never naked and globular or gall-like in form.
- h. Mouth-parts always present in adult female; adult male with compound eyes or ocellanae.
- i. Adult female with all legs present and subequal in length.
- j. Antennae of adult female consisting of eight to eleven segments, rarely only seven, articulated to ventral aspect near lateral margin of head; cuticle never bearing short truncate setae; rostrum consisting of two or three segments; adult male with compound eyes.

MONOPHEBINAE.

- jj. Antennae of adult female consisting of seven short segments, articulated to ventral aspect as far from lateral margin as from each other; cuticle usually bearing short truncate setae; rostrum consisting of two inconspicuous segments; adult male with ocellanae.

COCCINAE.

- i. Adult female either with all legs wanting or with all but one pair wanting, if all legs are present, one pair is two or three times as

- long as either of other pairs; antennae, if present, consisting of less than seven segments, often vestigial or wanting; adult male with ocellanae. ----- CYLINDROCCINAE.
- a. Mouth-parts always wanting in adult female; adult male with compound eyes.
- i. Prothoracic legs of adult female and male not greatly thickened and fitted for digging, normal in form; insects arboreal.
- j. Abdomen normal in form, all segments fully exposed, none of them infolded or invaginated to form marsupial pouch for carrying eggs; anus and vulva always opening to exterior; abdominal spiracles, when present, usually consisting of more than three pairs.
- k. Abdomen of adult female usually with less than eight pairs of spiracles, if with eight pairs, spiracles never open and their spiracular tracheae never provided with one or more rings of cerores; rectum of nymphal females never strongly chitinized and forming a rectal tube, never bearing anacerores; antennae consisting of eight to ten segments. ----- KUWANINAE.
- kk. Abdomen of adult female with six to eight pairs of spiracles, spiracles usually large and broad and open with spiracular tracheae with one or more rings of cerores; rectum of nymphal females strongly chitinized, forming tube bearing one or more rings of anacerores which excrete long glassy hair-like tube eight to ten times as long as entire body; antennae consisting of five to eleven segments. ----- XYLOCCINAE.
- jj. Abdomen abnormal in form, only two or three cephalic segments exposed, remainder infolded or invaginated to form marsupial pouch for carrying eggs; anus and vulva never opening to exterior but within and at cephalic end of marsupial pouch; abdominal spiracles limited to segments one to three; antennae consisting of ten to eleven segments. ----- CALLIPAPPINAE.
- ii. Prothoracic legs of the adult female and male always thickened and fitted for digging, fossorial; insects root inhabiting; antennae consisting of eleven segments. ----- MARGARODINAE.
- gg. Adult female usually with anal ring with anal ring setae, if without, female nymphs always provided

with anal ring with anal ring setae; body of adult female sometimes naked and globular or gall-like in form.

- h. Adult female and female nymphs usually with anal ring bearing anal ring setae, if anal ring or anal ring setae are wanting in adult female, body always bearing numerous cerores and completely covered with white mealy or powdery wax; body of adult female never naked and globular or gall-like in form.
- i. Abdomen of adult female bearing long marsupium formed of fused parallel plates or lamellae of hard white wax excreted from pilacerores; antennae consisting of four to nine segments; rostrum consisting of two segments; adult males with compound eyes. . . . . ORTHEZIINAE.
- ii. Abdomen of adult female never bearing marsupium formed of fused parallel plates of hard wax and never provided with pilacerores; male always with ocellanae.
- j. Antennae of adult female with eleven segments; female nymph and adult female with anal lobes wanting; always with anal ring with anal ring setae; rostrum consisting of three segments; adult male with ocellanae forming almost a complete ring around head. . . . . PHENACOLEACHINAE.
- jj. Antennae of adult female always with less than eleven segments, five to nine segments, sometimes rudimentary or wanting; female nymphs always with anal lobes, usually distinct; adult females with anal lobes, sometimes only slightly indicated; adult female sometimes without an anal ring and anal ring setae, but first female nymph always with anal ring and anal ring setae; rostrum consisting of two segments; adult male with ocellanae few in number and not arranged so as to form an almost complete ring around head. . . . . ERIOCOCCINAE.
- hh. Adult female rarely with anal ring and female nymphs always with anal ring and anal ring setae; body of adult female gall-like in form and usually found only on species of oak; cerores few in number, venter sometimes but entire body never completely covered with powdery or mealy wax; body usually grayish or brownish in color, frequently polished; antennae of adult female consisting of six segments, rudimentary, or want-

ing; rostrum consisting of two segments.-----

KERMESINAE.

- ff. Body of adult female always flask-shaped or peg-top-shaped; abdomen with sides either strongly convergent caudad, narrower and longer than thorax or thorax globular in outline and abdomen minute plug-like protuberance; thorax with prothoracic and mesothoracic legs shorter than metathoracic legs and nearer together; species gall inhabiting; antennae consisting of three to five segments or wanting; males with ocellanae.-----

APIOMORPHINAE.

- ee. Female nymph of at least one stage and usually also adult female provided with octacerores; body often provided with dorsal cribiform plates but never with ventral cribiform plates; antennae consisting of four to six segments or tuberculate; rostrum consisting of single segment.-----

ASTEROLECANINAE.

- dd. Body of adult female always with mouth-parts at one end and three tubular projections at other, one projection bearing anus and other two mesothoracic spiracles, usually with associated spine-like projection; always enclosed in resinous cell with three adjacent openings; each mass of wax containing one to many individuals; mesothoracic spiracles always associated with stigmatic processes located near anus; legs and antennae wanting; rostrum consisting of two segments. -----

TACHARDINAE.

- cc. Abdomen of adult female always longitudinally cleft at caudal end with pair of opercula at cephalic end of cleft; sides of cleft rarely fused with loss of line of fusion; cuticle rarely provided with octacerores, if so, never provided with dorsal or ventral cribiform plates; antennae consisting typically of seven to eight segments, sometimes greatly reduced or wanting; rostrum consisting of single segment.-----

LECANINAE.

- bb. Legs always present and body always covered with leaf-like scale without exuviae; fibio-tarsal sutures always obsolete; abdomen provided with cerores but never with ceratubae; antennae consisting of three segments; rostrum consisting of two segments.

CONCILASPINAE.

- aa. Abdomen of adult female with segments divided into two groups, cephalic series of four flexible movable segments forming preabdomen and caudal series of fused inflexible segments forming pygidium; dorsal aspect of abdomen without cerores and always with ceratubae; ventral aspect sometimes provided with gonacerores; body always covered with leaf-like scale containing one or two exuviae; legs wanting, antennae tuberculate; rostrum consisting of single segment. -----

DIASPIDINAE.

## CHAPTER V

### SUBFAMILY MONOPHLEBINAE

#### *The Giant Coccids*

The body of the adult female is rotund or strongly convex on the dorsal and flat on the ventral aspect. The cephalic, the caudal, and the lateral margins are broadly convex. The segments are generally well defined. The caudal end of the body is not inflated and the cephalic and lateral margins are not provided with a keel. The antennae are prominent, usually consist of eight to eleven segments, and are articulated to the ventral aspect of the head near each lateral margin. The eyes are present. There is a single ocellana located on each side of the head near the articulation of an antennae. The mouth-parts are always present, the rostrum consists of two or three segments, rarely of only a single segment, and the rostralis is long and slender. The legs are present. They are subequal in length and normal in form. The profemora are never enlarged and the prothoracic legs are never fitted for digging. The trochant-femoral and tibio-tarsal sutures of all the legs are always distinct. The spiracles of the mesothorax and metathorax are normal in form and ventral in position. The mesothoracic spiracles are never located near the anus. The abdominal spiracles are located on the lateral or dorsal aspect, are variable in number, varying from eight pairs to none, and are never large in size. The spiracular tracheae of the abdominal spiracles are not provided with one or more rings of cerores. The stigmatic clefts, spinae, and canellae are wanting. The abdomen is about as long as the head and thorax together. It is convex on the dorsal and ventral aspects, is never depressed. The lateral margins are uniformly convex. All of the segments are fully exposed and subsimilar in appearance with coriae between them, none are retracted to form a marsupium. The abdomen is never provided with an anal cleft and opercula, an anal ring and anal ring setae, or anal lobes and anal setae. The caudal abdominal segment is never short and narrow and extending beyond the other segments. The body is provided with cerores none of which are octacerores or pilacerores and is never provided with ceratubae. The body is never enclosed in a resinous cell with three adjacent openings or covered by a scale with or without exuviae, but may be more or less covered or associated with white powdery wax or loose woolly excretion of wax or may rest upon a large mass of wax with or without a fluted surface and with an internal mass of doughy wax. The rectum is never provided with a long glassy tube of wax or with a chitinized tube bearing rings of anacerores. The body is never naked and gall-like in form.

The female nymphs of all stages are provided with a rostrum of two or three segments and a long rostralis. The three pairs of legs are

always present in all nymphal stages and are similar in form. The profemora are never greatly enlarged and the prothoracic legs are never fitted for digging. The body is never provided with an anal cleft and opercula, an anal ring and anal ring setae, anal lobes and anal setae, octacerores, pilacerores, or ceratubae. The caudal end of the rectum is sometimes modified into a strongly chitinated rectal tube provided with one or more rings of anacerores, but not excreting a long glassy tube of wax. The caudal abdominal segment is not short, narrow and projecting.

The male has compound eyes and may have an ocellus along the caudal margin of each compound eye. The abdomen is either provided with long lateral filaments or is without such structures, never provided with tufts of long filaments of wax. The stylus is small or wanting.

The subfamily Monophlebinae contains about fifteen genera and about ninety species. While certain of these genera are limited to species from the old world and others to species from the new world, the larger more important genera contain species from all parts of the world so that they can be said to be universal in their distribution. The species are found mainly in tropical regions but a few extend into or have been introduced by commerce into subtropical and the warmer temperate regions. A few species sometimes become established under glass in north temperate regions.

Coccids are generally considered as being of small or minute size. This is true of the great majority of the species. The subfamily Monophlebinae nevertheless contains some species of considerable size. Species that are twelve millimeters or one-half inch in length are of common occurrence, while some of the species of certain genera as *Llaveia*, attain a length of twenty-five millimeters or one inch. It is not strange, since this subfamily contains the most generalized coccids, that it should include species of considerable size, but species that are of considerable size, not only for coccids, but for insects in general.

The best known species of this group in America is the citrus pest, the Cottony Cushion Scale or Fluted Scale, *Icerya purchasi*. The life history of this species, because of its economic importance, has been studied more intensely than that of any other. The following account, based in great part upon the descriptions of this species, is offered in place of a detailed statement of the serial development of the group as a whole, since our knowledge is too limited at this time to prepare such a statement.

The recently hatched nymphs are reddish yellow in color. The body is ovate in outline with the dorsal surface convex and the ventral aspect more or less flattened. The antennae are long



and consist of six segments which are enlarged so that the distal portion of the flagellum is distinctly clavate. This enlargement is located in the segment which bears several short setae and about four setae which are longer than the entire antennae. There is a single ocellana located on each side of the head on a tubercle which is situated near the articulation of an antenna. The segmentation of the body is indistinct but more distinct than is usual with coccids and more distinct than in the later nymphal stages of this species. The rostralis extends as a loop into the long deeply invaginated crumena. The head, thorax, and abdomen bear numerous cerores which are arranged in longitudinal rows, one along each lateral margin and four others between them. These cerores form transverse rows, two on the head, three on the prothorax, two each on the mesothorax and metathorax, and one on each of the nine abdominal segments. The setae are numerous, placed among the cerores and like them arranged in transverse rows. The cuticle bearing each seta is swollen, pimple-like, and forms a chalaza. The calyx marking the articulation of each seta to its swelling is distinct. On the antennae, legs, and rostrum the setae are of the ordinary type. The setae are longer on the lateral than on the mesal portions of the body, while the six setae at the caudal end of the abdomen, three on each side of the meson and known as the anal chalazae, are as long as the entire body. These setae are always borne by large swellings. The short, smooth, transverse areas between the cerores and chalazae mark the position of the coriae. The legs are normal in form and all their sclerites are easily identified. Each coxa bears a distinct coxartis which articulates against a coxacoila located in a curved linear episternum. The ental surface of this sclerite is produced as a distinct apodema. The thoracic spiracles are normal in position. Each contains a prominent spiracularia extending into the body cavity from the cephalic margin of the peritreme, which in the case of the metaspiracle is connected with the mesapodema. The abdominal spiracles are very small and difficult to identify. They are located in two pairs on the seventh and eighth abdominal segments. The rectum is chitinized forming a rectal tube bearing rings of anacerores. The portion of the rectum situated between the anus and the rectal tube is flexible and not strongly chitinized. The sexes are indistinguishable during this nymphal stage.

The individuals of the first nymphal stage of this subfamily are, so far as known, characteristic in form. The long clavate

antennae and the long prominent chalazae will serve to distinguish them. The number of antennal segments varies with the genus and in many cases even with the species.

The female nymphs of the second stage of *purchasi* are difficult to recognize because of the variation in their size. The antennae instead of being articulated to the margin of the body as in the first nymphal stage are articulated to the ventral aspect. They consist of the same number of segments, six, but the fourth and fifth segments are of the same length and much shorter than the other segments. The cerores are more numerous and, because of the more numerous longer chalazae, the segmentation is more difficult to determine. The cerores and chalazae are more prominent near the margin of the body. While the swellings of the anal chalazae are easily identified, their setae are only slightly longer than the other setae. The thoracic and abdominal spiracles are similar in number and position to those of the first nymphal stage. There is a small round projecting area on the meson of the ventral aspect of the caudal end of the body. This structure is a discaloea and appears to be wanting or is only imperfectly developed in the first nymphal stage.

The female individuals of the third nymphal stage, because they intergrade in size between the large individuals of the second nymphal stage and the small adults, are also difficult to identify. The antennae have more than six segments, typically nine, but individuals with seven or eight are not uncommon. A difference in the number of segments of the two antennae of the same individual is not unusual. The number of chalazae and cerores is greatly increased. They are arranged in a distinct band around the margin of the abdomen. The six anal chalazae can only be identified with difficulty. The thoracic and abdominal spiracles are similar in number and position. The spiraculariae are distinct. The rectal tube is trumpet-shaped in this stage and the rings of anacerores, if present, have not been identified. The discaloea is large and distinct. There is a smaller but similar structure located on each side of the mesal discaloea. The mesal structure may be known as a mesodiscaloea and each of the others as a latadiscaloea. The form of the discaloeae has been used by some systematists in differentiating species of this and other genera. They have designated them as the vaginal discs, the vaginal areoles, the ventral scars, and the subcircular scars.

The adult females of *purchasi* are easily recognized by the

presence of the broad band of cerores and chalazae extending around the margin of the abdomen and onto the sides of the thorax. The presence of a partially or completely formed ovisac, which is always formed in this species, is also positive proof of the condition of the specimen. They vary from two and one-half to four millimeters in length. The antennae consist typically of eleven segments, but adult females with antennae of ten segments or even of nine are not rare. The parts of the head skeleton, the rostrum, the rostralis, and the crumena are much larger than in the nymphs, but do not differ in structure. The parts of the thorax are similar but larger. The ventral aspect of the mesothorax and metathorax contain distinctly invaginated furcae. The furcellae have not been identified. The spiracles of the thorax and abdomen are similar in number, form, and position to those of the nymphs. The vulva is located in the caudal part of the ventral aspect of the seventh segment. There is in certain genera a large ventral gland, sometimes eversible, located caudad of the vulva. This is often more distinct than the vulva and may be present in the nymphal females as well as in the adult while the vulva is present only in the adult. It is not impossible but that the mouth of this gland, because of its distinctness, has been described as the vulva in certain cases. The discalocae, three in number, are located just caudad of the vulva. They are distinct black spots and can be recognized in untreated specimens. The segments of the abdomen are campanulate and the anus is located in the ninth tergum. The chitinized rectal tube and rings of anacerores can not be identified. The body of the untreated adult female shows distinct transverse constrictions, the coriae, which are obscured in mounted specimens by the stretching of the cuticle.

The eggs are deposited in a large white ovisac which is excreted from the cerores along the margin and near the ventral aspect of the body. As the wax is excreted the thorax and abdomen are elevated until the body of the insect is held almost at right angles to the surface of the host-plant. The ovisac is frequently much larger than the body of the insect, often two or three times its length, and according to the observations of Coquillett and Gossard requires from sixty to ninety days for its completion. The rostralis remains attached to the host-plant during all this time. The wax constituting the central portion of the ovisac has a fibrous cottony texture in ovisacs that have been dried for some time, but this wax has a doughy stringy consistency in ovisacs covered by living

females. The wax is excreted from the cerores of the ventral aspect and surrounds the eggs. The threads of wax from the different cerores melt together as they come into contact. The characteristic external part of the ovisae is formed by the marginal band of cerores. The fluted external surface is produced by the scalloped arrangement of the bands of cerores. The homogenous appearance of the wax is due to the melting together of the wax from adjacent cerores. The fine granular wax of the dorsal aspect is excreted by the cerores of this region. The long glassy threads of wax are poured from the very large cerores of the dorsal aspect. The cerores excreting these glassy threads are more abundant upon the head and thorax. The difference in the appearance of the wax of the dorsal aspect and that of the ovisae is probably due to the fact that in the former the cerores are distant from each other and there is no opportunity for the threads from adjacent cerores to melt together.

The large fluted ovisae of *purchasi*, while characteristic of this species, is not found even in all the species of the genus *Leerya*. The females of the great majority of the species of this subfamily do not form ovisae of the *purchasi* type, although all of them form a greater or less abundance of white wax. This wax is usually described as cottony and as forming indefinite masses which are used as much by the female in covering her body as in covering her eggs. A striking exception to this is found in the genus *Stigmatococcus*, where the body of the adult female is enclosed in a thin more or less spherical hard waxy test with an apical aperture through which half of the body of the female may be extruded. A few species live in ant's nests and the amount of wax excreted is always small.

The female, as soon as a thin sheet of wax marking the beginning of the ovisae is formed, begins to deposit her eggs. The number of eggs in *purchasi* varies according to the condition of the plant upon which the female has been feeding. Gossard counted 600 to 800 while Koebele counted over 1,000 in a single ovisae.

The life history of the male has not been so accurately described as that of the female. In the first nymphal stage, the males are indistinguishable from the females, but in the second nymphal stage differ in having a longer more slender body and longer and stouter antennae and legs. The antennae consist of six segments and are similar in form to those of the female.

The nymphal males of the third stage are said to be easily recognizable through their longer, narrower, flatter bodies. In each successively older nymphal stage of the female there is an increase in the number of cerotes and setae, while in the male there is a corresponding decrease in the number so that the body of the male at this time is almost bare. The antennae consist typically of nine segments. The male as it approaches the close of its third nymphal stage becomes less active and seeks a place where it can conceal itself under some projecting piece of bark or under some leaves. Having found such a place, it excretes a flossy mass of wax threads which adhere together when they come into contact with each other. The nymph forms a covering or cocoon from this wax by the movements of its body.

When the formation of the cocoon is completed, the nymph becomes quiescent and soon molts and transforms to a legless individual. The nymph is quiescent throughout this period, the fourth nymphal stage, and differs from the individuals of the previous period in that it has lost its rostralis and is unable to feed. It has also lost its nymphal legs and antennae and has in place of them the developing antennae and legs and wings of the adult. The insect is quiescent throughout the fourth nymphal period which ordinarily lasts about three weeks. This is the so called pupal stage of many writers.

The adult males are reddish insects with long, slender, ten-segmented antennae. The mesothoracic wings are comparatively large while the metathoracic wings are represented by a pair of halteres each of which bears two hooks which fit in a fold in a mesothoracic wing. The abdomen is without the long slender lateral prolongations of each side of certain of the caudal abdominal segments so characteristic of many of the males of this subfamily.

The following table for the separation of the genera of the Monophlebinae is very unsatisfactory. It is based for the most part upon generalities, upon the amount and form of the wax excreted by the adult female and the number of antennal segments. These are characters of slight value in differentiating genera because of their great variation even in the same species. Such genera as *Lophococcus*, *Aspidoproctus*, *Stigmaecoccus*, and *Perissoneumon*, which are based upon definite structural characters of the body, are readily recognized. The size of the insects, the great number of structural characters, the largest found in any group of coccids, and the presence of structures not present in other

coccids should make it possible to define the genera so that they would have definite limits and without having to utilize the covering of wax or the number of antennal segments. The form, number, and arrangement of the cerores; the form, number, and position of the abdominal spiracles; the apodemae; the spiraculariae; and numerous other characters should be found useful. It is to be hoped that some investigator with typical specimens of the genera will make a careful morphological and phylogenetic study of the subfamily.

#### GENERA OF MONOPHLEBINAE

- a. Abdomen of male with two or four pairs of slender lateral filaments; female unknown. .... *Monophlebus* Leach.
- aa. Abdomen of male with or without slender lateral filaments, if with filaments, never with two or four pairs; female usually known.
  - b. Antennae of adult female normally with nine or eleven segments.
    - c. Antennae of adult female normally with eleven segments, if with nine or ten segments, female provided with distinct ovisac located between body of female and host-plant, its outer surface frequently ribbed or fluted.
    - d. Wax excreted by adult female powdery or cottony, soft and indefinite in form, not forming definite ovisac.
      - e. Body of adult female with isolated dorsal areas of powdery or cottony excretion, body never entirely concealed by excretion.
        - f. Body of adult female elongate with powdery or cottony wax; vulva normal in size and position; abdomen of male with four pairs of slender lateral filaments. .... *Harvia* Sign.
        - ff. Body of adult female strongly convex and dorsum with transverse bands of powdery wax; vulva large and distant from caudal end of body; abdomen sometimes with single pair of spiracles; abdomen of males without slender lateral filaments. .... *Palaeocorcus* Ckll.
      - ee. Body of adult female completely covered by dense fine cottony excretion of long threads of wax, entirely concealing body of female; male unknown. .... *Guerinella* Fern.
    - dd. Wax excreted by adult female definite in form and usually hard, forming definite ovisac located between body of female and host-plant, its outer surface usually ribbed or fluted; dorsal aspect of body with powdery wax and frequently margined with erect or decumbent processes of wax; abdomen with spiracles on segments seven and eight or six to eight; abdomen of males without slender lateral filaments or with single pair of short blunt projections. .... *Icerya* Sign.
  - cc. Antennae of adult female with less than eleven segments.

- d. Antennae of adult female normally with ten segments.
- e. Wax excreted by adult female powdery or cottony, soft and indefinite in form.
  - f. Adult female without abdominal spiracles; abdomen normal in form, not with stout erect spine on dorsum; abdomen of male with four pairs of slender lateral filaments. ----- *Tessarobelus* Montr.
  - ff. Adult female with distinct abdominal spiracles; abdomen abnormal in form, with short, stout, erect spine on dorsum shaped like the spine on a military helmet; male unknown. ----- *Lopococcus* Ckll.
- ee. Wax excreted by adult female definite in form and usually hard, in shape of conspicuous lamellas or processes which conceal body more or less.
  - f. Vulva normal in position and size, not conspicuous, and not covered by hinged flap or valve of wax; male unknown. ----- *Walkeriana* Sign.
  - ff. Vulva abnormal in size, covered by thin valve or flap of wax hinged at cephalic end, supposed to form a receptacle for the eggs and nymphs; male unknown. ----- *Aspidoproctus* Newst.
- dd. Antennae of adult female normally with nine segments, body of adult female with powdery or cottony covering of wax; cuticle soft; abdomen of male with five pairs of slender lateral filaments. ----- *Drosicha* Walk.
- bb. Antennae of adult female normally with less than nine segments.
- c. Antennae of adult female normally with eight segments.
  - d. Abdomen of adult female whether provided with spiracles or not, never with large crescent-shaped valve-like structure located between them.
  - e. Abdomen with seven or eight pairs of spiracles.
    - f. Abdomen of adult female with eight pairs of spiracles, pair on first abdominal segment; body of adult female enclosed in more or less spherical hard waxy test with apical aperture; male unknown. ----- *Stigmaeococcus* Hemp.
    - ff. Abdomen of adult female, if bearing spiracles, provided with seven pairs of dorsal spiracles, those of first abdominal segment wanting; body of adult female not enclosed in spherical hard waxy test, but excreting a distinct oviscæ formed of numerous white threads which sometimes fuse and form a fluted surface; abdomen of males with three or four pairs of lateral filaments. ----- *Greeniella* MacG.
- ee. Abdomen with six pairs of spiracles; head between and caudad of antennae with setaceous clypeus-like lobe, covering rostrum in part; antennae consisting of eight to nine segments; setae clavate or knobbed at distal end; body spherical; male unknown. ----- *Mimosicerya* Ckll.

- dd. Abdomen of adult female provided with seven pairs of subdorsal spiracles; abdomen with large crescent-shaped valve-like structure located between spiracles; test unknown; male unknown. ----- *Prissopacamon* Newst.
- cc. Antennae of adult female normally with less than eight segments.
  - d. Antennae of adult female normally with seven segments; wax excreted by adult female not prominent; male unknown. *Monophlebulus* Ckll.
  - dd. Antennae of adult female with less than seven segments.
    - e. Abdomen with caudal end not bearing bifurcate setae; body with mealy covering of wax and with transverse ridges of wax on abdomen; antennae of adult male consisting of six segments, sixth segment subequal in length to each of others; male unknown. ----- *Cockerellella* MacG.
    - ee. Abdomen bearing bifurcate or serrate or broadly truncate setae.
      - f. Abdomen with caudal end bearing three or four bifurcate setae on each side of meson; antennae consisting of six segments in first and third nymphal stages, sixth segment twice as long as any of other segments; rostrum consisting of two segments; male unknown. ----- *Newsteadella* MacG.
      - ff. Abdomen of adult female margined on each side with bluntly or sharply serrated setae or broad blunt setae, these setae also present in all nymphal stages; antennae of adult female consisting of four to six segments, of second and third nymphal stages of five to six segments, and of first nymphal stage of four to five segments; rostrum apparently consisting of a single segment; adult male unknown. ----- *Stictococcus* Ckll.

The foregoing table to the genera of Monophlebinæ has made it necessary to change the position of certain of the species. The following list gives their generic reference:—

**Monophlebus** Burm.—This genus is limited to males, two species of which, *atripennis* Burm., the type, of which only males are known, and *dubius* Fabr., each have two pairs of lateral filaments on the abdomen, and a third, *saundersii* Westw., has four pairs of lateral filaments. All these species are from the East Indies. The following three species based upon females from Kilimanjaro, Africa, are referred to this genus by Newstead: *sjöstedti* Newst., *pallidus* Newst., and *africana* Newst. A single species, *dugesi*, from Mexico has been described by Vayssiere. It is not likely that these latter species are congeneric with the type of *Monophlebus*.

**Llaveia** Sign.—There are eight species included in this genus, as follows:—*axin* Llave from Mexico on *Spondias*, *Jatropha*, mango; *bouvari* Sign. from Guatemala; *cacti* Ckll. (not Linnaeus) from the



West Indies on cactus; *championi* Ckll. from Panama, known only in the male sex, transferred from *Tessarobelus* which contains a single species from New Caledonia; *mexicanorum* Ckll. from Mexico on Acacia; *primitiva* Towns. from Mexico on "Nettle-tree;" *uhleri* Sign. from Ecuador; *luzonica* Ckll. from Philippine Islands. The following table based upon one published by Cockerell will aid in the separation of the American species:—

## SPECIES OF LLAVEIA

- a. Body large, length of adult female 15 to 25 mm.
  - b. Body with scant pubescence; length 15 to 18 mm.; antennae short, segments, except the distal, broader than long. .... *bouvieri* Sign.
  - bb. Body with abundant pubescence; length 23 to 25 mm.; legs and antennae reddish.
    - c. Species from Mexico; antennae with cuticle densely covered with short setae, segments two to eight times as broad as long, nine and ten broader than long. .... *arin* Llave.
    - cc. Species from Ecuador. .... *uhleri* Sign.
- aa. Body small, length of mounted specimens of adult female about 7 mm.; legs and antennae dark sepia brown.
  - b. Cuticle of body densely covered with setae; antennae long, segments two to six not twice as broad as long, segments six to ten longer than broad, segment eleven narrow and cylindrical. .... *primitiva* Towns.
  - bb. Cuticle of body with minute, sparse, scarcely noticeable setae; antennae short, segments two to eight twice as broad as long, segments nine and ten considerably broader than long, segment eleven oval. .... *mexicanorum* Ckll.

**Palaeococcus Ckll.**—The following species are included in this genus:—*australis* Mask. from Australia on *Ilakea*; *braziliensis* Walk. from South America; *ewarti* Newst. from West Africa on "Peppet;" *fortis* Ckll. from Natal on *Eucalyptus*; *fulleri* Ckll. from Natal on grass; *fuscipennis* Burm. from Europe on oak, maple, fir, pine; *hellenicus* Genn. from Greece on *Pinus*; *mexicanus* Ckll. & Parr. from Mexico on *Prosopis*; *morrelli* Ckll. from Arizona; *nudatus* Mask. from Australia on *Cosmos*, *Verbena*; *plucheae* Ckll. from New Mexico on *Pluchea*; *pulcher* Leon. from Java on *Ilex*; *rosae* R. & H. from Florida, Jamaica, Mexico on *Amerstia*, *Euphorbia*, *Prosopis*, rose, sugar-apple, lime, lemon, *lignum-vitae*; *theobromiae* Newst. from Calabar, West Africa on Cacao; *townsendi* Ckll. from New Mexico on *Townsendia*, *Gutierrezia*, *Pieradenia*, *Grindella*, Bahia, Ferris has studied three of the above species, *morrelli* Ckll., *plucheae* Ckll., and *townsendi* Ckll. Each of these species has a large marsupium in the adult female which opens on the ventral aspect just caudad of the metathoracic legs. The opening after it is filled with eggs is closed by a flap of wax. These species may not be congeneric with the type of the genus, *fuscipennis* Burm.

**Guerinella Fern.**—This name was proposed by Mrs. M. E. Fernald

for *Guerinea* which is preoccupied. It includes a single species, *serratulæ* Fab. from Europe and Algeria on *Serratula*.

**Iceerya** Sign.—This is the largest genus of the subfamily so far as number of species is concerned. The following are included:—*aegyptiaca* Dougl. from Egypt, Ceylon, India, Australia on *Picus*, *Croton*, *Goodenia*, *Aristochlia*; *albolutea* Ckll. from West Africa on *Anona*; *brasiliensis* Hemp. from Brazil on *Liriodendron*, *Laurus*, *Codiaeum*; *candida* Ckll. from Philippine Islands; *colinensis* Ckll. from Mexico; *crocea* Green from Ceylon on *Citrus*, *Croton*, *Cocculus*; *genistæ* Hemp. from Brazil on *Genista*, *Lespedeza*, *Fragaria*; *jacobsoni* Green from Java on *Dombeya*; *koebelæi* Mask. from Australia on *Leptospermum*, *Acacia*; *littoralis* Ckll. from Mexico on *Croton*, *Mimosa*; *longisetosa* Newst. from German East Africa on *Acacia*; *minor* Green from India on mango; *montserratensis* R. & H. from West Indies, Mexico on *Chrysophyllum*, *Clusia*, palms, orange, banana, avocado pear; *natalensis* Dougl. from Natal on *Acacia*, orange, lemon; *okadae* Kuw. from Japan on orange; *palmeri* R. & H. from Mexico on *Coursetia*, grape-vine; *pilosa* Green from Ceylon on grass; *purchasi* Mask. from Australia, New Zealand, Fiji Islands, Hawaiian Islands, California, Louisiana, Florida, Mexico, West Indies, South Africa on *Pittospermum*, *Acacia*, Cypress, orange, lemon, pine, rose, grass, etc.; *rileyi* Ckll. from New Mexico, Mexico on *Larrea*, mesquite; *schrottkyi* Hemp. from Brazil; *seychellarum* Westw. from Seychelles Islands, Mauritius, China, Formosa on citrus, *Podocarpus*, guava, palms, rose, sugar cane; *subandina* Leon. from Argentina on *Bulnesia*; *tangalla* Green from Ceylon on *Gutierrezia*; and *zeteki* Ckll. from Panama Canal Zone. The following tables based upon tables published by Riley and Howard may be found useful in separating the included American species:—

## SPECIES OF ICERYA

## FIRST STAGE NYMPHS

- a. Abdomen with lateral setae cephalad of six anal chalazae minute, always much less than one-eighth length of anal chalazae.
- b. Antennae with distal segment bearing many long setae, five of which are especially long. ----- *seychellarum* Westw.
- bb. Antennae with distal segment bearing less than five especially long setae.
- c. Antennae with distal segment bearing four especially long setae; abdomen not emarginate between caudal pair of anal setae. ----- *purchasi* Mask.
- cc. Antennae with the distal segment bearing two especially long setae; abdomen emarginate between the caudal pair of anal setae. ----- *aegyptiaca* Dougl.
- aa. Abdomen with lateral setae cephalad of six anal chalazae not minute, about one-fifth length of anal chalazae.
- b. Antennae with distal segment not constricted near middle and enlarged on proximal half, sides uniformly convex. ----- *montserratensis* R. & H.

- bb. Antennae with distal segment constricted near middle and proximal half distinctly swollen, two sides of distal segment not uniformly convex. .... *palmerii* R. & H.

## ADULT FEMALES

- a. Body furnished with many long glassy filaments of wax arising from dorsal cerotes.
- b. Body supported by ovisac with distinct longitudinal flutings. .... *purchasi* Mask.
- bb. Body supported by ovisac without longitudinal flutings. .... *seychellatum* Westw.
- aa. Body not furnished with long glassy filaments of wax.
- b. Body supported by ovisac with prominent longitudinal flutings; tufts of wax bordering dorsal aspect limited to two at each end, each tuft usually much longer than entire ovisac. .... *montserratensis* R. & H.
- bb. Body supported by ovisac with only faint longitudinal flutings; tufts of wax bordering dorsal aspect ten or more in number, longest not much longer than ovisac. .... *egyptiaca* Dougl.

**Tessarobelus Montr.**—A single species, *guerinii* Montr., described from New Caledonia on Melaleuca and Filices, is included.

**Lophococcus Ckll.**—This genus includes a single species, *mirabilis* Ckll., from Natal on Mimosa. Newstead has described a variety, *mirabilis tricornis* Newst., from Dutch Southwest Africa and Vayssiere a second species, *vuilleti*, from West Africa on Acacia.

**Walkeriana Sign.**—The following species are included in this genus:—*andreae* Green from Congo, Africa; *compacta* Green from Ceylon; *euphorbiae* Green from Ceylon on Euphorbia; *floriger* Walk. from Ceylon on Litzaea; *pedicil* Green from Ceylon on Dodonaea; and *senex* Green from Ceylon on Dodonaea.

**Aspidoproctus Newst.**—A single species, *pertinax* Newst., was originally described from Central Africa. Two additional species, *armatus* Newst. on Acacia and *maximus* Newst. on *Brachystegia*, have been added from German East Africa, while Vayssiere has added *bouvieri* Vays. from French Equatorial Africa and *serrei* Vays. from Batavia, Java.

**Drosicha Walk.**—The following species belong in this genus:—*burmeisteri* Westw. from Java, China, Japan on pine; *contrahens* Walk. from Ceylon, North China; *corpulenta* Knw. from Japan on oak; *crawfordi* Mask. from Australia on Eucalyptus; *illigeri* Westw. from Tasmania; *leachii* Westw. from India; *lichenoides* Ckll. from Philippine Islands on Ficus; *maskelli* Ckll. from Java, China, Japan on Ficus, Gardenia, pine; *raddoni* Westw. from West Africa.

**Mimosicorya Ckll.**—A single species, *hempeli* Ckll. from Brazil on Mimosa(?), is included. Newstead has described and figured this coccid with considerable detail and proposed the new generic name *Clypeococcus* for it.

**Stigmacoccus Hemp.**—This genus includes a single species, *asper* Hemp. from Brazil, where it is found in the nests of *Campanotus* and upon the bark of *Inga*.

**Greenella MacG.**—The following species, originally referred to the genus *Monophlebus*, are included in this genus:—*dalbergiae* Green from India; *stebbingii* Green from India on *Ficus*, *Dalbergia*, *Arcocarpus*, mango, is the type; and *tamarinda* Green from India on branches of tamarind.

**Perissopneumon Newst.**—A single species, *ferox* Newst., described from India from the nests of ants is the type. Newstead has described a second species, *zimmermanni* Newst. from German East Africa.

**Monophlebulus Ckll.**—There is only a single species, *fuscus* Maskell described from Australia, included in this genus.

**Newsteadella MacG.**—A single species, *formicarum* Newst., collected in the nests of ants in India and originally described as a species of *Icerya*, is included.

**Cockerelella MacG.**—This genus includes a single species, *townsendi* Ckll. from the Philippine Islands. It was originally described as a species of *Monophlebulus*.

**Stictococcus Ckll.**—A genus containing four species:—*sjustedi* Ckll. from Cameroons, Africa from the stalks of the pods of *Theobroma*; *multispinosus* Newst. from Kilimanjaro, East Africa; *dimorphus* Newst. from German East Africa; and *formicarius* Newst. from Upper Congo, Africa from the hollow stems of *Barteria* and *Cuviera*. This genus, originally referred to the *Lecaniinae* and later to the *Dactylopiinae*, appears to belong to the *Monophlebinae*.

## CHAPTER VI

### SUBFAMILY KUWANINAE

#### *The Sinoran Coccids*

The body of the adult female is rotund or convex on the dorsal and flat on the ventral aspect. It is elongate elliptical, broadest in the thoracic region. The lateral and caudal margins are convex, not subtransverse. The segments are well defined. The caudal end is not inflated and the cephalic and lateral margins are not provided with a keel. The antennae are prominent, consist of eight to ten segments, and are articulated to the ventral aspect of the head near each lateral margin. The eyes are present. There is a single ocellana located on each side of the head near the articulation of an antenna. The mouthparts, rostrum and rostralis, are always wanting. The legs are present. They are subequal in length and normal in form. The profemora are never enlarged and the prothoracic legs are never fitted for digging. The trochantro-femoral and the tibio-tarsal sutures of all the legs are always distinct. The spiracles of the mesothorax and metathorax are normal in form and ventral in position. The mesothoracic spiracles are never located near the anus. The abdominal spiracles are located on the ventral or subventral aspects, are variable in number, and are never large in size. The spiracular tracheae of the abdominal spiracles are provided with one or more rings of cerores. The stigmatic clefts, spinae, and canellae are wanting. The abdomen is about as long as or longer than the head and thorax together. It is convex on the dorsal and ventral aspects, never depressed. The lateral margins are convex or subconvex and the caudal end is convex, never subtruncated. All the segments are fully exposed and similar in appearance with distinct coriae between them, none are retracted to form a marsupium. The abdomen is never provided with an anal cleft and opercula, an anal ring and anal ring setae, or anal lobes and anal setae. The caudal abdominal segment is never short and narrow and extending beyond the other segments. The body is provided with cerores, none of which are octacerores or pilacerores, and is never provided with ceratubae. The body is never enclosed in a resinous cell with three adjacent openings or covered by a scale with or without exuviae. It may be covered more or less or associated with white mealy or powdery wax or loose filaments of wax. The rectum is never provided with a long glassy tube of wax or with a chitinized rectal tube bearing rings of anacerores. The body is never naked and gall-like in form.

The female nymphs of all stages are provided with a rostrum of two or three segments and a long rostralis. The three pairs of legs are always present in first nymphal stage, so far as known, wanting in all others. The profemora are never greatly enlarged and the

prothoracic legs are never fitted for digging. The body is never provided with an anal cleft and opercula, an anal ring and anal ring setae, anal lobes and anal setae, octacerores, pilacerores, or ceratubae. The caudal end of the rectum is not chitinized, forming a rectal tube provided with one or more rings of anacerores excreting a long glassy tube of wax. The caudal abdominal segment is not short, narrow, and projecting.

The male has compound eyes. The abdomen is never provided with long lateral filaments, but may be provided with tufts of long wax filaments. The stylus may be large and prominent.

This subfamily contains six genera and six species, two species from Japan, one from Ceylon, one from Russia and England and two from California. The complete life cycle of only one species, one of the American species, is known.

The most striking difference found in the different genera is in the number of abdominal spiracles. *Paragreonia* according to Ferris has eight pairs, while the spiracles of segments seven and eight are greatly reduced and are but little more than points for the attachment of their spiracular tracheae. The presence of this number of abdominal spiracles is of interest, because eight pairs of abdominal spiracles on segments one to eight is the maximum number found in the abdomen of any embryonic, immature, or adult insect. *Steingelia*, which has six pairs of abdominal spiracles according to the description and figures of Green, has lost those of segments seven and eight. *Kuwania* has four pairs of abdominal spiracles on the four cephalic segments and has lost those of segments five to eight. It might be assumed since no abdominal spiracles are figured or described in *Matsucoccus* that there existed a beautiful series from the maximum number of *Paragreonia* to their entire absence in *Matsucoccus*. Since no thoracic spiracles are described or figured in *Matsucoccus* and since the spiracles are frequently considered of little systematic value and are frequently omitted from figures and descriptions, it is more likely that when specimens of this genus are examined, not only thoracic but abdominal spiracles will be found. The other characters of *Matsucoccus* are of sufficient importance to make it worthy of consideration as a distinct genus.

#### GENERA OF KUWANINAE

- a. Antennae with ten segments; abdomen apparently without spiracles; female nymph of first stage with femur of each leg enlarged and elongated, distinctly longer than combined tibia and tarsus and claw, so that legs are crab-like in appearance. -----*Matsucoccus* Ckll.
- aa. Antennae with less than ten segments; abdomen always with spiracles.

- b. Antennae with nine segments.
  - c. Abdomen with eight pairs of spiracles. ----*Paragreenia* MacG.
  - cc. Abdomen with less than eight pairs of spiracles.
    - d. Abdomen with seven pairs of spiracles; all nymphal stages known, normal in form. -----*Americoccus* MacG.
    - dd. Abdomen with four cephalic segments with pairs of spiracles. *Kuwania* Ckll.
- bb. Antennae with less than nine segments.
  - c. Antennae with eight segments; abdomen with spiracles on segments one to six; nymphal female of first stage not with femur of each leg enlarged and elongated.-----*Steingelia* Nassanow.
  - cc. Antennae with seven segments; abdomen with spiracles on segments one to six; adult female with rostrum and rostralis present. -----*Stomococcus* Ferris.

**Matsucoccus** Ckll.—A single species *matsumurae* Kuwana from Japan on pine-tree (*matsu*), is known. The adult female has a swollen body which is ovate in outline. When ready to deposit her eggs, the female seeks a crack or crevice in the bark, where she forms a cottony cushion of wax upon which she rests and covers her body with a considerable amount of white cottony wax. The nymphs of the first stage have the body similar in form to that of the adult female, but the legs have a peculiar crab-like appearance due to the swollen and elongate femora and the short and slender tibiae and tarsi. The antennae of this stage, which consist of seven segments, are peculiar in form. Segments two, four, and six are subequal in length as are segments three, five, and seven, but the segments of the last group are only about one-third the length of the segments of the first group.

**Paragreenia** MacG.—Green has described a single species, *zeylanica*, from Ceylon on *Antidesma*. The complete description of this species has not been published. The body of the adult female is long and narrow and the female nymphs of the second stage are found in small cavities in the living tissue of the plant. The adult female according to Ferris has well developed mouth-parts with a distinct mentum and six to eight pairs of abdominal spiracles. If this species has mouth-parts, rostrum and rostralis, in the adult female, this genus should be referred to the *Monophlebinae*.

**Americoccus** MacG.—There is a single described species, *fasciculensis* Herbert, from California on *Pinus*. The adult female has transversely striated antennae, the proximal segments are large. The claws are simple with two unequal digitules. The thoracic spiracles are large and distinct. The dorsum is provided with transverse rows of simple cerores and the dorsum and venter with cerores similar to the octacerores. The ocellanae, one on each side of the head, are present. The mouth-parts are sometimes present. The distance between the prothoracic and mesothoracic legs in the first nymphal female is nearly three times that between the mesothoracic and metathoracic legs. The rostrum is shown between the latter pairs of legs.

**Kuwania** Ckll.—Kuwana has recorded a single species, *quercus* Kuwana, from Japan on *Quercus*. This genus, as here limited, contains

only the type species. The adult female has an elongate oval body with all the surfaces convex. The antennae consist of nine segments and are articulated to the head near each other. The tarsal claws are without digitules. The nymphs of the first stage do not have crablike legs, their femora and tibiae and tarsi are normal in form. The antennae in this stage consist of six segments. The distal segment is greatly enlarged, clavate, and longer than all the other segments together. In the other nymphal stages the legs are wanting, the antennae are more chitinated points, and each of the four cephalic abdominal segments is provided with a pair of spiracles.

**Steingelia Nassanow.**—The type of this genus, *gorodetskia* Nassanow, was described from Russia. It was described a little later by Green from England on birch as *Kuwania britannica*. Green considers the two species as synonymous. The adult female of *Steingelia* is very different in general appearance from either of those previously described. The body is long and slender, three or four times as long as broad, and the lateral margins are parallel or nearly so. The antennae consist of eight or nine segments and are articulated to the cephalic portion of the head and near to each other. The body of the adult female is greatly shriveled during ovoposition and covered with a woolly secretion of wax, forming an ovisac for holding the eggs. The ovisac may be placed in crevices in the stems of old birch trees, but are found more abundantly among the decayed leaves and debris at the base of the trees. The nymphs of the first stage do not have crab-like legs. Their antennae consist of six segments. The sixth segment is the longest, the second, third, and fourth are the smallest, and the fifth is broadly dilated.

**Stomacoccus Ferris.**—There is a single species, *platani* Ferris, from California on *Platanus*. Its most distinctive feature is the retention of mouth-parts in the adult female. The body is elongate as in the other species of the subfamily. The thoracic legs are wanting in all nymphal stages but the first. This character will have to serve for differentiating the genera of this subfamily from the *Monophlebinae*. The single species differs from *Steingelia* in having a single row of setae on each side of the ventro-meson of the abdomen, while there are two rows on each side in *Steingelia*. There are six unguis digitules in *Stomacoccus*, eight to ten in *Steingelia*, and none in *Kuwania* but its claws are toothed. *Kuwania* has a group of about eight tenent setae on each coxa which are wanting in *Stomacoccus*. The insect apparently passes the winter upon the bark, migrating onto the leaves in spring. They live exposed upon the underside of the leaves. The males are very active. This genus was overlooked until after this chapter was in type.



## CHAPTER VII

### SUBFAMILY XYLOCOCCINAE

#### *The Melratuban Coccids*

The body of the adult female is rotund or convex on the dorsal and flat on the ventral aspect. It is elongate elliptical or rotund and globular, broadest in the thoracic region. The lateral margins are convex and the caudal margin is subtransverse or uniformly convex. The segments are well defined. The caudal end of the body is not inflated and the cephalic and lateral margins are not provided with a keel. The antennae are prominent, consisting of five to eleven segments and are articulated to the ventral aspect of the head near each lateral margin. The eyes are present. There is a single ocellana located on each side of the head near the articulation of an antenna. The mouth-parts, rostrum and rostralis, are always wanting. The legs are usually present. They are subequal in length and normal in form. The profemora are never enlarged and the prothoracic legs are never fitted for digging. The trochantro-femoral and the tibio-tarsal sutures of all the legs are always distinct. The spiracles of the mesothorax and metathorax are small and inconspicuous and ventral in position or are large and conspicuous. The mesothoracic spiracles are never located adjacent to the anus. The abdominal spiracles are located on the lateral or ventral aspects, six or eight pairs, and are large in size. The spiracular tracheae of the abdominal spiracles are frequently provided with one or more rings of cerores. The stigmatic clefts, spinae, and canellae are wanting. The abdomen is about as long as the head and thorax together. It is convex on the dorsal and ventral aspects, never depressed. The lateral margins are convex and the caudal end is subtruncated or convex. All of the segments are fully exposed and similar in appearance with distinct coriae between them, none are retracted to form a marsupium. The abdomen is never provided with an anal cleft and opercula, an anal ring and anal ring setae, or anal lobes and anal setae. The caudal abdominal segment is short and narrow, small and inconspicuous, and extends beyond the other segments or is normal in form and not protruding. The segments are not campanulate. The body is provided with cerores, none of which are octacerores or pilacerores, and is never provided with ceratubae. The body is never enclosed in a resinous cell with three adjacent openings or covered by a scale with or without exuviae, but may be more or less covered or associated with white, mealy, powdery, or filamentous wax. The rectum is rarely if ever provided with a long glassy tube of wax or with a chitinized rectal tube bearing rings of anacerores. The body is never naked and gall-like in form.

The female nymphs of all stages are provided with a rostrum of two segments and a rostralis. The three pairs of legs are present in the first

nymphal stage and wanting or greatly reduced in size and inconspicuous in the second, third, and fourth; and when present are similar in form. The profemora are never greatly enlarged and the prothoracic legs are never fitted for digging. The body is never provided with an anal cleft and opercula, an anal ring and anal ring setae, anal lobes and anal setae, octacerores, pilacerores, or ceratubae. The caudal end of the rectum is strongly chitinized and provided with one or more rings of anacerores excreting a long glassy tube of wax. The caudal abdominal segment is short, narrow, and projects beyond the other segments; the segments are not campanulate.

The male has large coarsely faceted compound eyes and are not provided with ocelli. The abdomen is not provided with long lateral filaments, but bears tufts of long filaments of wax. The stylus is short and conical.

The typical genus, *Xylococcus*, of the subfamily Xylococcinae was based upon the species filiferous Löew, described in 1882 as infesting *Tilia europaea* and *T. grandifolia* in Austria. Four species have been described from North America, betulae Pergande from birch and poplar from the Lake Superior region, and three species from California, quercus Ehrhorn from live oak, macrocarpae Coleman from the Monterey cypress, and alni Florence from alder. Two species have been described from Japan by Kuwana, napiformis from oak and matsumurae. The first species has been made the type of a new genus, *Matsueoccus* by Cockerell. It has been placed in the subfamily Kuwaniinae. The second species, judging from the figures and descriptions of the species, the presence of mouth-parts in the adult female, and the presence of anal setae and apparently anal ring setae in the first nymphal stage, has no relation with the genus *Xylococcus* as here defined and probably belongs to the Eriococcinae.

The most complete account of the life history of any of the species of *Xylococcus* is that given by H. G. Hubbard and Th. Pergande of the birch xylococcid. The account of Florence based upon the study of the three species found upon the Pacific Coast confirms for the most part and amplifies the excellent account of these observers. The following descriptions are based upon the work of these writers.

The adult female is ordinarily buried in a cavity in the bark. The eggs are deposited in a depression formed by the collapse of the ventral portion of the abdomen of the female and the sides of the opening in the bark.

The young nymphs, when they emerge from the egg, seek a place like other coccids of the first nymphal stage, where they can

attach themselves. The young nymph works its way in between the layers of bark or enters a lenticel or breathing pore. The insect by its growth and the excretion of wax causes the layers of bark to separate and curl, producing areas where the bark is roughened and covered with splits and curls. The bark also in its growth surrounds the body of the coccid forming a cavity in which it rests.

The body of the first stage nymph is more or less depressed, without tubercles, without an anal ring, but with the caudal abdominal segment, the ninth, a short transverse tubercle-like projection. The caudal abdominal segments are never campanulate as is characteristic of these segments of many coccids. There is a row of large ceriores, varying in number in the different species, on the ventro-meson. The females and males are similar during the first nymphal stage but quite different during the other nymphal stages and for this reason they will be considered separately. The nymphs are provided with prominent legs, rostrum, rostralis, and antennae of six segments each.

The females at the first molt lose their legs and antennae, but retain their mouth-parts. The body is somewhat depressed and sack-like. There are two other molts producing two other nymphal stages, four in all. The nymphs differ in general appearance only in being successively larger. The insect, since it has no legs and also because of its location, is stationary during these stages. The fourth molt produces an adult female which is provided with distinct nine-segmented antennae and legs. The rostrum and rostralis are lost at this molt so that the insect is unable to feed. Ferris calls attention to the fact that in certain individuals of *macrocarpae* a complete series can be shown of practically every stage from a complete absence of mouth-parts to mouth-parts which are apparently functional. He does not specify whether it is only the rostrum or labium that is present or both rostralis and rostrum. There is a striking difference in this condition as the rostralis must be present in order that the insect can procure food. The body of the adult female is distinctly segmented and the two ends are more or less truncated. The insect is now able, if it desires, to leave its cavity in the bark and to wander about which it sometimes does. But it is ordinarily so deeply buried in the bark that it is unable to leave its cell and in fact does not entirely free itself from the cast cuticle of the fourth nymphal stage. In such cases the caudal end of the molted cuticle

is ruptured and the female presents the end of her body at the crevice in the bark for the reception of the male.

The nymphs which develop into males never form pits like those of the female nymphs. They are apt to assemble in the vicinity of some older females and to establish themselves under the protection of her accumulation of wax. This makes it possible for them to escape later.

The males of the first nymphal stage are, as noted, similar to the females. They differ from the females in that at the first molt they do not lose their antennae and legs. They also retain their rostrum and rostralis and feed like the females.

According to Pergande the males molt five times and pass through five nymphal stages. Florence in the species which she examined only found four nymphal stages. The male nymphs at the second molt, the third nymphal stage, lose their legs and antennae but retain their rostrum and rostralis. They closely resemble the female nymphs of the third stage. At the third molt the rostrum and rostralis are lost and the insect regains its legs and antennae. During this stage, the fourth nymphal stage, the insect leaves its waxy cyst and wanders about. The body is soon covered with little tessellations of cottony wax which forms a loose flocculent foliicle. The insect rests in this foliicle until ready for the fourth molt. Neither of the accounts make clear whether these legs and antennae are new nymphal appendages or are the appendages that are passed on later to the adult. At the fourth molt, which is usually passed under some sheltering fragment of bark the male appears with wing-pads and protuberances surrounding the genital organs. The fifth stage nymph wanders about freely for a time, but eventually covers itself with a cylindrical cocoon of threads of wax. It later breaks its way out of this foliicle, molts its cuticle for the fifth time, and transforms to a winged adult.

The adult male is provided with coarsely faceted compound eyes and is said to be without ocelli. The abdomen bears a short style, a long penis, and the sixth and seventh abdominal segments bear a dense brush of delicate thread-like filaments of wax. The metathoracic wings are of interest in that they contain veins, proving that the halteres of the males of the specialized families are modified wings. The males emerge during the fall and winter and females with eggs are found during the winter and spring. The eggs of a single female hatch over a long period of time, five to six weeks.

One of the striking features of the anatomy of the species of *Xylococcus* is the chitination of the caudal end of the rectum, forming the so-called anal tube. This chitinated portion is provided with one to three rings of anacerores. This structure is present in all the female nymphal stages. It becomes more and more highly organized with each successive stage. Pergande does not mention its presence in the adult female but states: "The anal opening is simple, situated on the underside of the abdomen close to the concavity, and with difficulty to be seen." Florence in her description of the adult female of each species, states: "Anal tube represented by an infolding of the body-wall and not strongly chitinated." It is apparent that the chitination of the rectum is peculiar to the nymphal stages as in *Coclostomidea* and *Icerya*. The function of the rings of anacerores is to excrete the long hair-like filament of glassy wax which is protruded through the anus. These filaments are often two inches or more in length and contain at the free end a viscid droplet of honeydew. The male is provided with a chitinated rectum in the first three nymphal stages and excretes a long glassy thread-like tube of wax like that of the female. This tube is lost in the male at the third molt. Where these insects are abundant, the large number of waxen threads give the bark a hoary appearance.

The body of the female and male nymphs is covered with cerores which are more abundant along the lateral and caudal portions. In this region there is excreted thick masses of wax which undoubtedly aids in the curling and splitting of the bark. The wax is in the form of curls which are consolidated into thick lamellae on the sides of the body.

The development of the respiratory system as described and figured by Pergande is unique. He does not mention or figure any thoracic spiracles but Hubbard states that "there are no spiracles anterior to the abdominal portion of the body in the female." This is corrected by Florence. She makes the following statement: "The insects have ten pairs of spiracles, two pairs on the thorax and eight pairs on the abdomen. Those on the abdomen have large simple openings, and within the body form stigmatal tubes which are anterior constrictions in which there are one or two rings of pores according to the instar. The thoracic spiracles have no stigmatal tubes. In the active stages their openings are marked by a small group of pores, and in the apodous stages these pores are wanting." The thoracic spiracles are evi-

dently inconspicuous and were overlooked by Pergande. In the female nymphs of the first stage the respiratory system consists of a very short unconnected spiracular trachea near each spiracle. Each of the tracheae is strongly constricted near the middle of its length. These constrictions contain one or more rings of cereres. With the growth and development of the nymph the spiracular tracheae elongate and fork. The branches of the forks elongate, the adjacent forks curve toward each other and finally fuse forming a continuous system of longitudinal tracheae on each side of the abdomen. Pergande in his description of the male nymph of the third stage states: "pores and stigmatic tubes similar to those of the female in the second stage."

This subfamily contains in addition to the genus *Xylococcus*, three other genera: *Coclostomidia* containing four Australian species described by Maskell with *zealandica* as type; *Ultracoclostoma* containing a single Australian species; and *Cryptokermes* containing a single Brazilian species.

The species of the above named genera agree so far as known with those of *Xylococcus* in that they are either provided with a chitinized rectal tube, excrete a long slender glassy tube of wax, or their spiracular tracheae are provided with rings of cereres. They differ, however, in the general shape of the body, which is not always deeply imbedded in the tissue of the host-plant but in some species is encased in a test of hard or comparatively hard wax and attached to the surface of the bark or only slightly imbedded. The legs and the antennae, although greatly reduced in size and inconspicuous, are present in certain species and the thoracic spiracles are large and prominent and the number of pairs of abdominal spiracles is usually less than in *Xylococcus*. The genera referred to this subfamily can be separated as follows:—

#### GENERA OF XYLOCOCINAE

- a. Adult female with nine-segmented antennae and with well developed legs; thoracic spiracles small and inconspicuous, at least in early nymphal stages, smaller than abdominal spiracles; abdomen with eight pairs of spiracles. ----- *Xylococcus* Loew.
- aa. Adult female with more or less than nine segments in antennae, but not with nine; legs wanting or well developed; thoracic spiracles large and conspicuous, always larger than abdominal spiracles; abdomen with six or seven pairs of spiracles.
- b. Antennae of adult female always distinct, consisting of five or more segments; abdomen, so far as known, with six pairs of spiracles.

- c. Antennae of adult female consisting of ten or eleven segments; second nymphal female with rudimentary legs; adult female with well developed legs; rostrum of nymphs consisting of two or three segments. ----- *Coclostomidia* Ckll.
- cc. Antennae of adult female consisting of five or six segments; second nymphal female and adult female without legs; rostrum of nymphs consisting of three segments. --- *Ultracoclostoma* Ckll.
- bb. Antennae of adult female wanting or represented by mere tubercles; legs greatly reduced, represented by small tubercles with large serrated claws; abdomen with seven pairs of spiracles; antennae of second nymphal female short six-segmented tubercles, legs tuberculate with minute claws; rostrum of nymphal females consisting of two segments. ----- *Cryptocermes* Hemp.

**Xylococcus** Loew.---Four American species of *Xylococcus* have been described. These can be separated by the following table based upon that of Florence. Two species only are recognized by Ferris. The species on alnus is considered the same as the species on birch which is also recorded from beech. He records *betulae* Pergande from Ontario, Canada, New York, and Michigan.

#### SPECIES OF XYLOCOCCLUS

- a. Abdomen of first nymph with caudal portion of ventral aspect with single mesal pore; rectal tube of apodous nymphal stages of female with single ring of anacerores.---California on *Cupressus*.-----  
*macrocarpae* Coleman.
- aa. Abdomen of first nymph with caudal portion of ventral aspect with more than one mesal pore; rectal tube of apodous nymphal stages of female with two groups of anacerores, cephalic and caudal group.
- b. Rectal tube of apodous nymphal stages of female with only single ring of anacerores in caudal group; abdomen in first nymphal stage with caudal portion of ventral aspect with mesal row of five pores.---Lake Superior Region on *Betula*.--- *betulae* Pergande.
- bb. Rectal tube of apodous nymphal stages of female with more than one ring of anacerores in caudal group.
- c. Rectal tube of apodous nymphal stages of female with two rings of anacerores in caudal group; abdomen in first nymphal stage with caudal portion of ventral aspect with mesal row of two to four pores.---California on *Quercus*. --- *quercus* Ehrhorn.
- cc. Rectal tube of apodous nymphal stages of female with three rings of anacerores in caudal group; abdomen in first nymphal stage with caudal portion of ventral aspect with mesal row of six or seven pores.--- California on *Alnus*.----- *alni* Florence.

**Coclostomidea** Ckll.---This genus contains four species, all from New Zealand:---*compressa* Mask. on *Podocarpus*; *pilosa* Mask. on *Podocarpus* and *Fagus*; *wairoensis* Mask. on *Phormium* and *Leptospermum*; and *zealandica* Mask. on *Muhlenbeckia* and *Rhipogonum*. The species of this genus have a similar structure of the rectum and excrete a tube of wax like the species of *Xylococcus*.

**Ultracoclostoma Ckll.**—A monotypic genus from New Zealand on *Fagus* and *Phyllocladus* containing the species *assimilis* Mask. This species excretes a slender white filament of wax from three rings of anacerorores.

**Cryptokermes Hemp.**—This genus was described from Brazil on the limbs and trunks of *Schinus*. The adult female and second stage nymph of the single species, *braziliensis* Hemp., has the rectum chitinized so as to form a rectal tube from which in the second nymphal stage there is excreted a stiff tube of wax through which honeydew is passed. The mouth-parts are reported as wanting by Ferris in the adult female and as present in all the nymphal stages. The abdomen is provided with six instead of seven pairs of spiracles in all stages. The legs are slender and typical of first stage monophlebids, short and stout, femur and tibia nearly as broad as long, in last nymphal stage; and wanting in the adult female. The caudal end of the first nymph bears four pairs of long anal chazalazae. The antennae are clavate and consist of six segments in the first nymphal stage; are short and stout in the last nymphal stage, consist of six segments, the segments three or four times as broad as long; and wanting in the adult female. The exuvia of the last nymphal stage serves as a puparium for enclosing the adult female.



## CHAPTER VIII

### SUBFAMILY MARGARODINAE

#### *The Ground Pearls*

The body of the adult female is rotund or strongly convex on the dorsal and flat on the ventral aspect. The cephalic, caudal, and lateral margins are broadly convex. The segmentation is indicated. The caudal end of the body is not inflated and the cephalic and lateral margins are not provided with a keel. The antennae are small, consist of six to nine segments, and are articulated to the ventral aspect of the head near each lateral margin. The eyes are wanting. The mouth-parts, rostrum and rostralis, are wanting. The legs are present and always different in form. The prothoracic legs are fitted for digging. The profemora are greatly enlarged and swollen, their tibiae are short, their tarsi and claws are fused and together are much longer than their tibiae. The mesothoracic and metathoracic legs are normal in form, their femora are not swollen and their tarsi and claws are not fused. The clays are as long as or longer than their tibiae. The trochantal-femoral and the tibio-tarsal sutures are always distinct. The spiracles of the mesothorax and metathorax are normal in form and ventral in position. The mesothoracic spiracles are never located near the anus. The spiracles of the first abdominal segment are ventral in position and those of segments two to seven or eight are usually dorsal. The spiracular tracheae of the abdominal spiracles are never provided with one or more rings of cerores. The stigmatic clefts, spinac, and canellae are wanting. The abdomen is about as long as the head and thorax together. It is convex on the dorsal and ventral aspects, never depressed. The lateral margins are uniformly convex. All of the segments are fully exposed and subsimilar in appearance, none are retracted to form a marsupium. The abdomen is never provided with an anal cleft and opercula, an anal ring and anal ring setae, or anal lobes and anal setae. The caudal abdominal segment is never short and narrow and extending beyond the other segments. The body is provided with cerores, none of which are octacerores or pilacerores, and never provided with ceratubae. The body is never enclosed in a resinous cell with three adjacent openings or covered by a scale with or without exuviae, but may be more or less covered with a white mealy or powdery wax or loose woolly threads of wax. The rectum is never provided with a long glassy tube of wax with a chitinized rectal tube bearing rings of anacerores. The body is never naked and gall-like in form.

The female nymphs, except the last nymphal stage, are provided with a one-segmented rostrum. The three pairs of legs or at least the prothoracic pair are present in the first nymphal stage and dissimilar in form. All of the legs are wanting in one or probably more nymphal stages. The profemora, when present, are enlarged and the prothoracic

legs are fitted for digging. The body is never provided with an anal cleft and opercula, an anal ring and anal ring setae, anal lobes and anal setae, octacerores, pilacerores, or ceratubae. The caudal end of the rectum is not chitinized, forming a rectal tube provided with one or more rings of anacerores excreting a long glassy tube of wax. The caudal abdominal segment is not short, narrow, and projecting.

The male has compound eyes and may have an ocellus along the caudal margin of each compound eye. The abdomen is not provided with lateral filaments. The caudal end of the dorsal aspect of the abdomen bears two tufts of long glassy filaments of wax. The stylus is apparently wanting.

This subfamily is best known from its typical genus, *Margarodes*. This was erected in 1828 by Guilding to include some insects found by him in the soil and in the nests of ants on the island of Bahama. The species, because of its association with ants, was given the name of *formicarium*. The cysts of the insects, known as ground pearls, occur in the soil in prodigious quantities and show in great number when the soil is plowed. Riley states that in certain parts of Florida they compose over one-half of the soil. In the Bahamas they were known according to Guilding as ant-eggs and were strung into necklaces and manufactured into various fancy articles and used for ornamental purposes long before they were recognized as one of the stages of an insect. A similar use for ground pearls has been reported by other writers who have seen ornaments made by the use of ground pearls as beads from South Africa and Australia, two South African species have been described since but the Australian species is still unknown. Guilding mistook the filaments of wax excreted from the openings in the cyst over the thoracic and abdominal spiracles for special organs developed for obtaining moisture by capillary attraction and named them siphones.

A complete detailed account of the serial development of any species of *Margarodes* from the egg to the adult has not been made. The number and form of the various nymphal stages of the female has not been determined and practically nothing is known as to the development of the male. The following account is based upon that of Green which is the most complete published thus far.

The eggs are deposited in the ground in a mass of filaments of wax excreted by the adult female. The nymphs of the first stage are typical in form and usually provided with three pairs of legs. This stage in one species, *mediterraneus*, has only the prothoracic legs present. The antennae in the first nymphal stage

normally consist of six segments, but there are only three present in the species named. The antennae of this stage of this species are peculiar in form for coccids. The proximal and the distal segments are, so far as shown, greatly swollen, much larger than the intermediate segments, and the distal segment is distinctly truncate. The greatly swollen prothoracic legs, which are fitted for digging, are characteristic not only of the first nymphal stage but of all the stages where the legs are present. The comparative size and length of each profemur are always much greater than the combined tibia and tarsus and claw. The nymph attaches itself to the root of a plant by its rostralis and feeds upon the sap. It is, quite likely that the sexes are, as among other coccids, indistinguishable in the first nymphal stage.

Green states that the nymphs apparently undergo several stages. Since he describes the individuals of the first nymphal stage as larvae, this would be in addition to these. The insects, while growing, according to Mayet, excrete the envelope or cyst that subsequently encloses the nymph. It is this so called cyst, because of its iridescence and wonderful pearly lustre, that has attracted the attention of observers and that has received the common name of Ground Pearl. Writers frequently speak of this stage of the insect as an encysted one, but this is not a true characterization as this term is ordinarily used in zoology. The insect is simply enclosed in a compact thin-walled case or scale which bears the same relation to the nymph as the cocoon to the pupa or as the wax or scale of other coccids does to the insect. This case is formed either entirely from wax excreted by the insect, entirely from the cuticle molted by the insect, or from a combination of the wax excreted by the insect and its molted cuticle. The cysts, when fully developed, are more or less irregular in form and composed of closely applied small overlapping flakes or plates. The overlapping of the plates gives the cyst the appearance of a minute pine-cone or swollen bud. The form and structure of the cyst would suggest that it is formed entirely of wax. The cysts vary considerable in color. What are apparently the young cysts are pale yellow, becoming darker with age until they are deep bronze brown in the oldest individuals. The amount of lustre also varies with the age of the cyst and as to whether the outer plates, which are usually dull, are wanting or not.

The various accounts would seem to carry the idea that the cyst was begun during the first nymphal stage. The female nymph at the first molt loses its legs and eyes. The antennae are repre-

sented by ringed disks bearing one or two curved setae. There is some disagreement as to the disappearance of the rostrum and rostralis. Giard maintains that they exist and are functional in all the nymphal stages but are small and inconspicuous and that they are not lost until the assumption of the adult condition. The later observations of Green would seem to confirm this contention of Giard.

Green has figured and described a stage of *niger*, which was obtained from small scales, which differs from all of the stages previously described. It is oval in outline and lacks legs. The antennae are represented by small tubercles with a pit bearing two curved setae. The mouth-parts are well developed. The abdomen bears seven pairs of spiracles instead of eight as in the adult. The sterna of the abdominal segments bear five longitudinal rows of small circular glandular pits or ceroses. A still earlier stage was observed. These may represent stages in the development of the male which is unknown.

The female *Margarodes* may remain apparently for a considerable time, several years, within their cyst if the conditions for their emergence are unfavorable. She eventually breaks through the wall of the scale and emerges as an insect that is normal in form at least for a coccid. The body is globular. The antennae are short, gradually tapering toward the distal end, varying with the species from seven to nine segments. The mouth-parts, including the rostrum and rostralis, are wanting. The prothoracic legs are greatly enlarged, the profemora are thickened and fitted for digging. The other two pairs of legs are normal in form. The body may be shaggy with fine short setae or nearly glabrous. The dorsal and ventral aspects may bear short conical spines, the dermal spines of Green. The lateral margins of the body and the dorsal and ventral aspects may bear transverse groups of ceroses with intermixed setae. The body becomes more or less covered with a white mealy or powdery wax or a loose woolly wax. The thoracic spiracles and those of the first abdominal segment open on the ventral aspect, while the remaining abdominal spiracles open on the dorsal aspect or on the lateral aspect as in *mediterraneus*. The thoracic spiracles are much larger than the abdominal. There are ceroses usually associated with both the thoracic and the abdominal spiracles. The anus and vulva are located on the ventral aspect. The former is small and surrounded by a chitinous plate. The adult females vary greatly in size. Green reports in the case of *papillosus* a variation of 1.14 mm. to 4 mm.

and in the case of *niger* 2 to 8 mm. and quotes the following from Giard: "according to the conditions of nutrition in which the nymph finds itself, the latter is able to transform itself into an adult female of very different sizes. Certain adult females of *M. vitium* are no more than 2 mm., while others attain a length of 5 or even 8 mm. As a result one often finds adult females smaller than some of the larvae."

The development of the male is unknown. Green assumed from collectors' notes that the males become encysted like the females, but their cysts have not been identified. The collectors reported the cysts "were fairly numerous and were obtained five to seven inches beneath the soil. The males were also enclosed in shells but emerged soon after excavating and were observed copulating toward evening." The adult males and females emerged in June in papilliosus and the cysts were reddish in color. In the case of *niger* the collector makes the following note: "Egg-masses of this Ground Pearl were observed in the soil at a depth of 2-3 inches. The cells in which the eggs were found were long-oval, lined inside with a coating of mealy wax. Hundreds of eggs were found filling up the interior of each cell. The dead mother scale—shrivelled and rotten—was to be found at one pole of the cell."

The legs of the adult male are similar to those of the female, the prothoracic legs which are used for digging into the soil in search of the female, are enlarged. The tibio-tarsal sutures are usually present but may be wanting. The claws of the mesothoracic and metathoracic legs are simple, rarely trifid. The antennae are long and slender and consist of ten to thirteen segments. They are ordinarily simple but may be branched or flabellate. The wings with numerous conspicuous veins show their affinity to the wings of the generalized *Gularostria*. The halteres are small and bear a single curved hook.

The two genera of *Margarodinae*, of which one is known only in the male sex, can be separated by means of the following table:—

#### GENERA OF MARGARODINAE

- |     |  |                             |
|-----|--|-----------------------------|
| a.  | Male with antennae simple and with tibio-tarsal sutures of mesothoracic and metathoracic legs present; adult female with abdominal spiracles, those of first abdominal segment located on ventral aspect and those of other segments on dorsal aspect, rarely lateral aspect | <i>Margarodes</i> Guilding. |
| aa. | Male with antennae distinctly flabellate and with tibio-tarsal sutures of mesothoracic and metathoracic legs obsolete; adult female unknown.   | <i>Neomargarodes</i> Green. |

**Neomargarodes Green.**—The genus *Neomargarodes* contains a single species, *erythrocephala* Green, based upon males collected in Algeria.

**Margarodes Guilding.**—A part of the species of *Margarodes* have been based upon characters drawn from the scale alone. Such characters have been shown to be worthless and consequently the characters necessary for the differentiation of the fourteen recognized species have not been indicated. The following characters drawn in the main from the papers of Green, who figures a prothoracic leg of six of the species, may be found useful in separating the species. There are four European species, *gallica* Signoret from France with nine segmented antennae, *polonicus* Linnaeus from southern Europe on *Scleranthus* with eight segmented antennae, *perrisii* Signoret from France with seven segmented antennae, and *mediterraneus* Silvestri from Italy on *Cynodon* with seven segmented antennae. This latter species has the profemur as long as its tibia and tarsus and claw together and the ventral surface of the profemur and the surface of the protibia bears several large setae. A species, *hameli* Brandt, from the borderland between Europe and Asia, in Armenia on *Poa*, has nine segmented antennae. The two South African species, *trimeni* Giard and *capensis* Giard, from Cape Colony, probably from the nests of termites, are easily separated. The profemur is shorter than the tibia and tarsus and claw together in *trimeni* and the ventral surface of the profemur bears only a few small scattered setae while the protibia bears a few more arranged in a single transverse row. In *capensis* the profemur is longer than its tibia and tarsus and claw together and the ventral surface of the profemur bears several minute setae while the protibia is glabrous. There are three species described from India by Green, *indicus* of which the antenna is unknown and in which the profemur is longer than its tibia and tarsus and claw together and in which the profemur bears four or five small setae on the ventral aspect and its protibia bears two setae on each side; *papillosus* has seven segmented antennae and its profemur is subequal in length to the combined tibia, tarsus, and claw and bears several small setae on the ventral aspect of the profemur and four or five setae on the protibia; and *niger* which differs from all of the other species so far as known in having the profemur three or four times as long as its tibia and tarsus and claw together, this latter combined structure is in the form of a strongly chitinated toothed claw. The South American species, *vitium* Giard from Chili on *Vitus*, has eight segmented antennae. The same number is present in *hiemalis* Cockerell from New Mexico. Of the two West Indian species, *formicarum* Guilding from Antigua and Bahama Islands from the nests of ants, has seven segmented antennae and the profemur is much longer than its combined tibia and tarsus and claw and bears numerous long large setae on the ventral aspect of the profemur and one on each side of the protibia, while the form of the prothoracic legs and the antennae of *rileyi* Giard from West Indies and Florida Keys is unknown. The figures of Green suggest that good diagnostic characters are to be found in the prothoracic legs and it is to be hoped that those having authentic specimens of the other species will publish figures of these structures.

## CHAPTER IX

### SUBFAMILY CALLIPAPPINAE

#### *The Marsupial Coccids*

The body of the adult female, as seen from the lateral aspect, is strongly inflated. The cephalic portion is thin and bluntly pointed, the caudal portion is much inflated or swollen and truncated. As viewed from above, the body is more or less triangular in outline, with a decided keel extending around the margin of the body, except across the truncated caudal portion. The segmentation is distinctly indicated by notches in the lateral rim or keel. The antennae are prominent, usually consist of ten segments, rarely eleven, and are articulated to the ventral aspect of the head near each lateral margin. The eyes are present. There is a single globular ocellana located on each lateral margin caudad of the articulation of an antenna. The mouth-parts, rostrum and rostralis, are always wanting. The legs are present. They are long and stout, subequal in length, and normal in form. The profemora are never enlarged and the prothoracic legs are never fitted for digging. The trochantro-femoral and tibio-tarsal sutures of all the legs are always distinct. The thoracic and abdominal spiracles are not definitely described and are not figured. The stigmatic clefts, spinae, and canellae are wanting. The abdomen is deeply invaginated or retracted and only the cephalic two or three segments are exposed, so that the head and thorax together are several times as long as the abdomen. It is strongly convex on the dorsal and ventral aspects and is never depressed. The lateral margins bear a rim and the caudal aspect is broadly truncated and bears a transverse slit, the entrance to the invaginated marsupium. The abdomen is never provided with an anal cleft and opercula, an anal ring and anal ring setae, or anal lobes and anal setae. The caudal abdominal segment is not short and narrow and extending beyond the other segments but is concealed in the marsupium. The body is sparsely provided with ceriores none of which are oetaceriores or pilaceriores and is never provided with ceratubae. The body is never enclosed in a resinous cell with three adjacent openings or covered by a scale with or without exuviae, but may be covered with a thin coating of powdery wax and sometimes with a pad of wax between the sternum of the thorax and the host-plant. The rectum is never provided with a long glassy tube of wax or with a chitinized tube bearing rings of anaceriores. The body is never naked and gall-like in form.

The female nymphs at least of the first stage are provided with a rostrum and rostralis. The three pairs of legs are always present in all nymphal stages so far as known and are similar in form. The profemora are never greatly enlarged and the prothoracic legs are never fitted

for digging. The body is never provided with an anal cleft and opercula, an anal ring and anal ring setae, anal lobes and anal setae, octacerores, pilacerores, or ceratubae. The caudal end of the rectum is not chitinized forming a rectal tube provided with one or more rings of anacerores excreting a long glassy tube of wax. The caudal abdominal segment is not short, narrow, and projecting.

The male has large finely faceted compound eyes. The ocelli are wanting. The abdomen is not provided with long lateral filaments but bears tufts of long wax filaments. The stylus is minute or concealed.

The name of the single genus, *Callipappus*, belonging to this subfamily, is derived from the two Greek words, *kallos* meaning beauty and *pappos* meaning grandfather, down, pappus, a floating seed. This undoubtedly refers to the resemblance of the male when on the wing to the floating cottony thistle-like seeds of certain plants. The beauty of the male is further shown in the vernacular name of one of the common species, The Bird of Paradise Coccid.

The females of this subfamily are among the largest of all the coccids. While specimens half an inch long are of common occurrence, others three times this size or an inch and a half or about thirty-five millimeters in length are not unusual. Individuals an inch in length are normal in size for certain species.

The most striking peculiarity in the female is the invagination or *intussusception* of the caudal portion of the abdomen. In the adult female all the segments but the first and second and in some individuals also the third are invaginated to form a pocket, pouch, or marsupium. This pouch extends almost to the cephalic end of the body. Since the caudal end of the body is simply pushed in, as it were, the vulva and anus retain their position in the invaginated part and are located on the inside of the cephalic end of the marsupium. The eggs are deposited within the marsupium and their development takes place there. The young when they hatch, escape through a transverse slit in the caudal end of the pouch, the mouth of the invagination. This slit is guarded by lips which are apparently different in form in the different species. The genus *Callipappus* has been variously associated with *Monophlebus*, *Icerya*, *Margarodes*, and *Xylococcus* from all of which it is structurally very different through the development of its marsupium and is regarded as worthy of consideration as a distinct subfamily.

The only condition allying *Callipappus* with *Margarodes* and *Xylococcus* is the lack of a rostrum and *rostralis* in the adult



female. The following quotation from Tepper shows how easily it is for one to be misled by appearances and how unwise it is to base statements regarding anatomical structures in this family on other than prepared specimens. "Mr. Maskell placed the species (*immanis* Maskell) in the genus *Coelostoma* 'on account of the absence of the rostrum' (op. cit. p. 51) and says 'there is no doubt of its being a monophlebid,' for both *Monophlebus crawfordi* and *Coelostoma australe* are known to possess a rostrum (sucking tube) of great length, which during life is deeply buried in the tissues of the bark of the twigs on which the insect is located, when, however, the organ is withdrawn it is at the same time retracted into the body; its extreme slenderness and the minuteness of the otherwise unmarked orifice rendering it next to impossible to detect its presence. Mr. A. Zietz informs me that he has frequently detached living *Monophlebi* from the bark and seen their rostrum retracted, and I have noticed in the present instance that the living insect (*Coelostoma*) had its body closely and immovably fixed to the twig by its rostrum, but later, when dead, had its forepart raised and the rostrum completely retracted. The absence of a rostrum, as a distinction, will, therefore, have to be omitted in future." It is true that living *Icerya purchasii* are able to conceal the rostrum under folds of the ventral aspect of the head and thorax when removed from the host-plant, but an examination of a specimen clarified in caustic potash will show that anatomically it is impossible for the insect to retract its mouth-parts and the only absolutely sure method of determining whether the mouth-parts are present or absent in a given species or specimen is the study of a properly prepared specimen.

The adult female is triangular in outline as viewed from above. The cuticle of the body contains circular areas with minute central projections, these will probably prove to be cereres. The cephalic end is pointed and the long tapering antennae of ten or eleven segments are articulated one on each side near the cephalic end of the pointed portion. The caudal end is broad and greatly swollen. The insect as viewed from either side is pointed at the cephalic end and gradually swollen until it reaches its greatest expansion at the caudal end. There is a distinct rim or margin which extends around the pointed cephalic end and along the middle of each lateral aspect to the large transverse truncated caudal end, where the rim is interrupted by the transverse slit leading into the marsupium. The legs are long and slender and

normal in form. They are articulated to the three large thoracic segments about equidistant from each other and the two ends of the body. The segmentation of the thorax and exposed abdominal segments is distinctly marked by indentations in the lateral rim. The female, after depositing her eggs in the marsupium, is very different in appearance and it is this form with the swollen abdomen that is usually described. There is a pad of wax excreted from the ventral aspect of the thorax. This wax attaches the female firmly to the bark of the tree upon which she is resting. Her legs are spread out around the twig or leaf in such a way that she has the appearance as Maskell states of apparently being afraid that she will fall off from the twig. The surface of the body is covered with white mealy wax with which is mixed some flakes of wax and some short cottony threads of wax.

The young female is figured by Signoret. The antennae consist, according to this author and Fuller, of six segments. The body has the lateral margin broadly convex and the two ends are bluntly pointed. The abdomen is represented as containing the full number of segments. The insect is figured as if in this stage it was distinctly coccid-like in form, which the adult females are not. The thoracic spiracles are figured by Signoret. The only reference to the spiracles that has been found is the following statement of Maskell dealing with a nymph of *immanis*. "In this specimen there is a very small quantity of whitish cotton under the anal region, and along the margin; just below what I have called a seam on the edge, are ten small circular specks of white, (five on each side), which may mark the position of the spiracles." It is probable that these represent the thoracic spiracles and a pair for each of the three exposed abdominal segments. It is striking that with insects so large in size, so bizarre in their structure, and so peculiar in their habits that no one has made a careful detailed study of one or all of the species. Even when and how the marsupium is formed has not been described. The invagination apparently takes place after the last molt.

The adult male, which is about a quarter of an inch long, has antennae of ten or eleven segments. The eyes are compound. The ocelli are not mentioned in descriptions but are probably present. The abdomen is distinctly segmented and without lateral projections and the caudal segment bears a large brush of long glassy filamentous threads of wax which are often spread out fan-shaped, in some individuals three times as long as the body,

resembling the plumes of a bird of paradise. These wax filaments do not appear for five or six days after the emergence of the male and require two or three days before they reach their complete development. The stylus is a short conical spike from which protrudes the penis which is very long and flexible. The wings are large with an expanse of two-thirds of an inch. The halteres are large and wide and each is provided with a single curved hook.

The males transform in cocoons made of a mass of white cottony threads of wax. They are placed on the ground among leaves and under pieces of sticks and bark near the trunks of the trees upon which the nymphs feed. The life cycle of the male or female has not been described.

**Callipappus Guerin.**—This genus contains six species, all are from Australia, the land of marsupial animals. The six described species are as follows:—*australis* Maskell on *Eucalyptus* and *Augophora*; *bufo* Fuller on *Casuarina* and *Banksia*; *farinosus* Fuller on *Casuarina*; *immanis* Maskell on *Acacia* and *Eucalyptus*; *rubiginosus* Maskell on *Banksia*; and *westwoodii* Guerin, the type of the genus, on *Eucalyptus*.

## CHAPTER X

### SUBFAMILY COCCINAE

#### *The Coccinal Insects*

The body of the adult female is broadly convex on all aspects with the two ends bluntly rounded. It is elongate oval in outline. The segmentation is distinct. The caudal end of the body is not inflated and the cephalic and lateral margins are not provided with a keel. The antennae are small but distinct, consist of five to seven imperfectly separated segments, and are articulated to the ventral aspect of the head near each lateral margin. The eyes are present. There is a single ocellana located on each lateral margin caudad of the articulation of an antenna. The mouth-parts, rostrum and rostralis, are always present and distinct, the rostrum consists of two indistinct segments. The legs are present. They are small, subequal in size and length, normal in form, and do not project beyond the lateral margin of the body. The profemora are never enlarged and the prothoracic legs are never fitted for digging. The trochantro-femoral and the tibio-tarsal sutures of all the legs are always distinct. The spiracles of the mesothorax and metathorax are small and ventral in position. The mesothoracic spiracles are never located near the anus. The abdominal spiracles are always wanting. The stigmatic clefts, spinae, and canellae are wanting. The abdomen is not quite as long as the head and thorax together. It is convex on the dorsal and flat on the ventral aspect, is never depressed. The lateral margins are convex or subparallel and the caudal end is broadly rounded. All the segments are fully exposed and similar in appearance with more or less distinct coriae between them, none are retracted to form a marsupium. The abdomen is never provided with an anal cleft and opercula, an anal ring and anal ring setae, or anal lobes and anal setae. The caudal abdominal segment is short and narrow, inconspicuous, not extending beyond the other segments. The body is provided with cerores none of which are octacerores or pillarcerores and is never provided with ceratubae. The body is never enclosed in a resinous cell with three adjacent openings or covered by a scale with or without exuviae, but is either completely covered or rests upon a thick mass of white cottony threads of wax. The rectum is not provided with a long glassy tube of wax or with a chitinated tube bearing rings of anacerores. The body is never naked and gall-like in form.

The female nymphs of all stages are provided with a rostrum and rostralis. The three pairs of legs are present in all nymphal stages and are similar in form. The profemora are never enlarged and the prothoracic legs are never fitted for digging. The body is never provided with an anal cleft and opercula, an anal ring and anal ring setae, anal

lobes and anal setae, octacerores, pilacerores, or ceratubae. The caudal end of the rectum is not strongly chitinized forming a rectal tube provided with one or more rings of anacerores excreting a long glassy tube of wax. The caudal abdominal segment is not short, narrow, and projecting.

The male has six ocellanae. The abdomen is not provided with long lateral filaments or tufts of long glassy filaments, but bears two long, slender, caudal filaments or threads of wax. The stylus is small and inconspicuous.

The most useful products for the production of permanent shades of red, carmine, or scarlet are derived from the cochineal insects, *Coccus cacti*. The dried bodies of these insects were used by the native Mexicans when the Spaniards under Cortes arrived in Mexico in 1518. There was much conjecture and discussion as to the true nature of cochineal. It was considered by Acosta as early as 1530 and later by others as an insect, but was generally believed to be the seed of a plant and was not definitely proven to be an insect until in 1694 by Hartsoeker and by Loeuwenhoek in 1704, who examined specimens carefully with a microscope.

This coccid feeds upon various species of *Cactaceae*, more often those of the genus *Opuntia*, but is said particularly, to feed upon the nopal plant, *Opuntia coccinellifera*, although this is denied by W. J. Hooker. The insects and the plants upon which they feed have been introduced and cultivated in many parts of the world. They were introduced by the French and Spaniards into Spain, Italy, and northern Africa, and various of the tropical islands of the Atlantic where the *Cactaceae* thrive. It was also introduced at an early date into India. Cochineal is stated to be produced commercially at the present time in Mexico, Peru, Algiers, and southern Spain. The discovery and introduction of the much cheaper but inferior and less permanent coal tar colors has supplanted in great part the use of cochineal. According to Humboldt and Westwood 800,000 pounds of cochineal were annually imported into Europe before the use of the cheaper dyes, of which 150,000 pounds, worth \$1,800,000, was used in England alone.

In collecting the insects they are carefully brushed from the surface of the plant into bags or sheets. They are killed by immersion in hot water or by exposure to the sun or the heat from steam or an oven. The difference in the appearance of the commercial product is due to the way in which it is treated. The grains or dried bodies are longitudinally folded or wrinkled or fluted. The best crop is secured early in the season by collecting the unimpregnated females. The specimens collected later in the

season consist in great part of young nymphs and molted skins which are consequently not nearly so rich in coloring matter. A pound of the dead females contains about 70,000 individuals. There are three grades of cochineal. The silver cochineal, which is greyish in color in which the furrows of the body are said to be covered or filled with a whitish bloom of fine down, is the best grade. This bloom is undoubtedly the wax excreted by the female after her removal from the host-plant and before her death. The other grades are black cochineal which is dark reddish brown and is destitute of the bloom and granilla which is an inferior grade collected from uncultivated or wild plants.

The living adult females of the genus *Coccus* are between two and three millimeters in length. The body is elongate oval in outline. The antennae are short and inconspicuous, the six or seven segments consisting of short chitinized rings connected by coriae of about the same length. They do not project beyond the lateral margin of the body. The legs are short and stout, similar in form. The femur of each leg is as long as its tibia and tarsus together. The rostrum consists of two segments. The thoracic spiracles are four in number, small, and ventral in position. The abdominal spiracles are wanting. The anus and vulva are inconspicuous. All portions of the external cuticle of the body bears bluntly truncated setae or tubercles as they are called which are very characteristic in form. The number of these setae present and their length and breadth varies with the species. There are a number of minute cerores arranged in groups of varying size scattered among the truncated setae.

The females, which are dark crimson in color, when they reach maturity, excrete a mass of white cottony threads of wax. The insects are either completely covered by this mass of wax or rest upon its surface. The eggs are deposited within the mass.

The nymphs of the first stage are similar in shape to the adult females, elongate oval in outline, and dark crimson in color. They have long legs that project beyond the sides of the body. The antennae, which also project beyond the margins of the body, consist of six segments with distinct constrictions between them. The dorsal aspect bears six rows of truncated setae, a longitudinal row along each lateral margin and four between them. There is a single transverse row on each abdominal segment and probably two for each thoracic segment and the head. The truncated setae are wanting on the ventral aspect. The females of the second nymphal

stage differ from those of the first nymphal stage not only in the presence of a large number of truncated setae but in their larger size. The individuals of this stage are very similar to the adult females.

The nymphs of the males form cylindrical cocoons with equally rounded ends of thick felted white wax. The adult male is dark crimson in color. The antennae consist of ten segments, each segment bearing short blunt tubercular setae. The caudal end of the abdomen bears two long very slender filaments of wax. The most striking feature is, as first pointed out by Newstead, the presence of two segments in the tarsus of each leg. The distal or second segment is as long as in the tarsi of all other coccids, but in addition to this segment, there is a minute segment, longer on the ventral aspect, between the second segment and the tibia.

There seems to be a difference of opinion as to what name shall be applied to the cochineal insects. Comstock and his predecessors called it *Coccus cacti* Linnaeus, but Cockerell states that some of the works cited by Linnaeus, as Reaumur, relate to the true cochineal insect, "but the whole of the Linnean description pertains to a monophlebid. The specimens described were collected in the island of St. Eustache by Daniel Rolander, and sent alive to Upsala in 1856. At the same time Rolander sent a number in alcohol to De Geer, who (Mem., vol. VI, p. 449) gave a full account of them with a figure." There is nothing in the account of De Geer to show that the specimens he received were a part of the collection sent to Linnaeus, whether it was sent at the same time and whether it was the same species or not is not clear. De Geer makes the following statement showing the source of his knowledge as to the Linnean specimens: "comme le rapporte M. de Linné." The evidence that the *Coccus cacti* of Linnaeus is not one of the cochineal insects is not positive and so long as it can not be proven that it is not, less confusion will result from the application of the generic name *Coccus* to the cochineal insects and the application of the name *cacti* to one of the species as has been done on the following pages. There are two genera referred to this subfamily. It is considered that only one of these, *Coccus*, in reality belongs here. The other genus is placed here tentatively. They can be separated by means of the following table:—

#### GENERA OF COCCINAE

- a. Body of adult female bearing varying number of short truncate setae; adult female and nymphal females without any trace of anal

lobes; antennae typically with seven segments, sometimes with six, some of intermediate segments longer than proximal or distal segments; rostrum consisting of two inconspicuous segments.—

*Coccus* Linnaeus.

- aa. Body of adult female bearing pointed setae, but never bearing short truncate setae; antennae always with six segments, always with distal segment longer than others; adult female with small inconspicuous microscopic anal lobes; rostrum not described.-----

*Epicoccus* Ckll.

***Coccus* Linnaeus.**—The following table based upon the descriptions and figures of Green will serve for the separation of the species:—

SPECIES OF COCCUS

- a. Body with truncate setae few in number, long and slender in form, width of their distal ends about one-fourth their length; cerores large with thick rims, arranged in clusters, each cluster consisting of two to twenty cerores, average twelve or thirteen; eyes cylindrical, longer than broad; body pruinose, without conspicuous tomentum.—Mexico, Canary Islands, Algeria, Spain, West Indies, Maderia, Peru, Florida, California, Guatamala, Italy, Cape Colony, India on *Opuntia*. ----- *cacti* Linn.
- aa. Body with truncate setae numerous and comparatively large, distinctly truncate, the width of the distal end about one-half their length; cerores small and without thick rims; eyes round or broader than long; body conspicuously covered with white tomentum.
- b. Antennae with distal segment subglobular, as broad as long; cerores small and inconspicuous, usually in clusters of three or four, rarely five to six; truncate setae stout, with parallel sides and distal end distinctly narrower than diverging sides of proximal half.—India, Ceylon, California, New York, Argentina on *Opuntia*. ----- *indicus* Green.
- bb. Antennae with distal segment longer than broad; cerores arranged in comparatively large clusters; truncated setae not as above.
- c. Antennae and legs very small, trochanter and femur .12 to .16 mm. in length; antennal segments much contracted, total length .10 to .11 mm.; cerores small and inconspicuous, in clusters of two to sixteen, average about sixteen; truncate setae numerous and conspicuous, variable in form, ranging from quite slender to short and broad and cylindrical.—Missouri, Arizona, New Mexico, California, Mexico, England on *Opuntia*. ----- *tomentosus* Lamar.
- cc. Antennae and legs larger, trochanter and femur .18 to .23 mm. in length; antennal segments comparatively broad and extended, total length .15 to .18 mm.
- d. Truncate setae elongate, cylindrical, slightly expanded at proximal end, diameter of proximal end one-half or slightly more than total length of the seta.



- e. Cerores small, in clusters of three to thirty-six, average fifteen; length of body 3.5 to 4.75 mm.—Texas, Arizona, New Mexico, Montana, Mexico on *Opuntia*.----*confusus* Ckll.
- ee. Cerores small, in clusters of four to thirty, average thirteen; length of body 2.5 to 3.0 mm.—Colorado, Texas, Arizona on *Opuntia*. -----*newsteadii* Ckll.
- dd. Truncate setae stout, shorter, cylindrical, diameter of proximal end usually more than one-half the total length of seta; cerores in clusters of one to thirty, average fifteen; length of body 2.5 to 3.5 mm.—Cape Colony, South Africa on *Opuntia*. -----*capensis* Green.

**Epicoccus Ckll.**—This genus contains a single species, *acaciae* Maskell from West Australia on *Acacia*. The species appears to be similar to those of the genus *Coccus* but lacks the truncate setae. The absence of an anal ring with anal ring setae in all stages excludes it from the *Eriococcinae* and the presence of legs in the adult female from the *Cylindrococcinae*. The highly colored naked body, according to Fuller one of the most beautiful of the Australian coccids, the body-wall bearing only a few cerores, and the six segmented antennae in the adult female and first nymphal stage are characteristic.

## CHAPTER XI

### SUBFAMILY ORTHEZIINAE

#### *The Ensign Coccids*

The body of the adult female is rotund, convex on all aspects. It is elongate oval in outline, broadest in the metathoracic region. The lateral margins are convex and the cephalic and caudal margins are bluntly rounded. The segments are well defined. The caudal end of the body is not inflated and the cephalic and lateral margins are not provided with a keel. The antennae are prominent, consist of four to nine segments, and are articulated to the ventral aspect of the head near each lateral margin. The eyes are present. There is a single ocellana located on a tubercle on each lateral margin caudad of the articulation of an antenna. The mouth-parts, rostrum and rostralis, are always present. The rostrum consisting of two distinct segments. The legs are present. They are subequal in length and normal in form. The profemora are never enlarged and the prothoracic legs are never fitted for digging. The trochantal-femoral and the tibio-tarsal sutures are frequently wanting. The spiracles of the mesothorax and metathorax are normal in size and ventral in position. The mesothoracic spiracles are never located near the anus. The abdominal spiracles are frequently distinct and located on segments one to seven. They are smaller than the thoracic spiracles, ventral or subventral in position, and their spiracular tracheae are not provided with rings of cerores. The stigmatic clefts, spinae, and canellae are wanting. The abdomen is distinctly shorter than the head and thorax together. It is convex on the dorsal and flat on the ventral aspect, never depressed. The lateral margins are convex and the caudal end is broadly rounded. All of the segments are fully exposed and similar in appearance with distinct coreae between them, none are retracted to form a marsupium. The abdomen is never provided with an anal cleft and opercula or anal lobes and anal setae. The anal ring is always distinct and provided with six anal ring setae. The caudal abdominal segment is short and narrow, small and inconspicuous, but normal in form and not extending beyond the other segments. The body is provided with cerores none of which are octacerores, but the great majority are pilacerores. Ceratubae are always wanting. The body is never enclosed in a resinous cell with three adjacent openings or covered by a scale with or without exuviae, but is always in great part covered by a mass of hard white wax which is fused together and forms distinct plates or lamellae, a part forming a marsupium which is carried by the female. The rectum is never provided with a long glassy tube of wax or with a chitinated rectal tube bearing rings of anacerores. The body is never naked and gall-like in form.

The female nymphs of all stages are provided with a rostrum and rostralis. The three pairs of legs are always present in all nymphal stages and are similar in form. The profemora are never greatly enlarged and the prothoracic legs are never fitted for digging. The body is never provided with an anal cleft and opercula, anal lobes and anal setae, octacerores or ceratubae. The anal ring is distinct and bears anal ring setae. The caudal end of the rectum is not chitinized, forming a rectal tube provided with one or more rings of anacerores excreting a long glassy tube of wax. The cuticle bears numerous pilacerores. The caudal abdominal segment is short and narrow but not projecting.

The male is provided with compound eyes and sometimes with three ocelli. The abdomen is not provided with long lateral filaments, but bears a delicate pencil of long slender threads of wax. The stylus is small.

The species of *Orthezia* are among if not the most beautiful of all coccids. Their beauty depends upon the size and form of the marsupium of the female and upon the size, complexity, and arrangement of the plates or lamellae of wax associated with the marsupium and attached to the dorsal aspect. The marsupium is constructed of symmetrically arranged glistening white plates or lamellae of wax, which are usually fused into a single tubular structure which is carried by the caudal part of the abdomen of the female. This tubular structure is attached to the abdomen and is held in many species in a more or less elevated position, the amount of elevation varying with the species. From this fact there has been derived their common name of the Ensign Coccids, since the movement of the marsupium when the insect is in motion resembles the waving of an ensign. The marsupium is formed by special groups of pilacerores located on the ventral aspect of the abdomen.

The pilacerores are peculiar to this subfamily. They are ordinarily designated as spines or glandiferous spines, but spines are large setae and all setae are provided with calices by which they are articulated to the cuticle. The calices are always wanting in these projections or pilacerores. There are generally a few minute setae with calices distributed among and between the groups of pilacerores. Each pilaceroris is a simple slender projection of the cuticle of the body-wall with a single opening, the oraceroris, at its distal end through which the wax is poured. That this is their true structure is beautifully shown by the figures of List. The pilacerores serve the double purpose of outlets for the wax and as threads for holding the plates of wax to the body after they have been excreted and become hard.

There are in addition to the pilacerores of the ventral aspect,

which excrete the wax forming the marsupium, other groups of pilacerores on the dorsal and lateral aspects of the head, thorax, and abdomen. The number and shape of the dorsal plates of wax is dependent upon the size and shape of these groups of pilacerores.

The tubular marsupium, which may be from twice to four or five times as long as the body, surrounds the vulva. The eggs as they are extruded pass into the marsupium where there is mixed with them a few long curly threads of wax which are formed by the ordinary cerores located on the ventral aspect among and between the pilacerores. The adult female is active and carries her marsupium about with her wherever she goes. The young nymphs when they hatch, crawl out through the open end of the marsupium and drop from this end onto the host-plant or crawl down its side and over the body of the female onto the host-plant. The beauty of the marsupium is due not only to its glossy white color, but also to its longitudinal flutings, which are produced by the irregularities or scallops in the row of pilacerores which form it. The flutings are usually wanting on the ventral aspect of the marsupium and vary in distinctness with the species on the dorsal and lateral surfaces. They are sometimes only slightly indicated.

The nymphs of the first stage have the body oval in outline with the cephalic and caudal ends broadly rounded. The legs are normal in form but are comparatively large and the sutures between the trochanter and femur and often also between the tibia and the tarsus of each of the legs are frequently wanting, or if indicated, the segments are fused and immovable. The dorsal and ventral surfaces of the body are provided with numerous pilacerores and a slight covering of wax is generally formed before the nymphs issue from the marsupium. The antennae consist of four to six distinctly separated segments. The anus is surrounded by a prominent anal ring which bears six large anal ring setae. There are numerous cerores, not pilacerores, located on the anal ring. These cerores differ from the cerores of the anal ring of many other coccids in not having a definite arrangement.

There are a number of nymphal stages in the female, four in insignis, in all of which the insect is active at all times. The nymphs resemble the adult female very closely so far as the number and disposition of their pilacerores are concerned, but they can be recognized always by the fact that the plates of wax are never as large as those of the adult because they are shed at each molt. The legs in the older nymphal stages, because of the

*increase in the size of the body, do not appear so large and so out of proportion with the remainder of the body. There is no difference in the anal ring, the anal ring setae, and the anal ring cercores between those of a nymph and those of the adult. The adult antennae contains from four to nine segments, the number varying with the genus.*

While abdominal spiracles have not been found in all the species of *Orthezia*, they have been found in all the species examined and it is probable that when all the species have been inspected for abdominal spiracles they will be found to be present. The evidence seems to point to the presence of seven pairs of abdominal spiracles in all species. Newstead was unable to find abdominal spiracles in *Newsteadia* and Ferris did not find them in *Nipponorthezia*.

The life cycle of the male has not been described. The females of *insignis* frequently occur upon plants in such numbers that the plants are white with them, but the number of males is always very small in comparison to the number of females. It is likely, judging from the published accounts, that the nymphs of the male are active during the first nymphal stage, but become more elongate during the second nymphal stage when they excrete loose woolly fibres of wax or dense masses of white wax which are used to form a cocoon. The insect is quiescent during the remaining nymphal stages. The wing-pads and developing legs of the adult soon become distinct.

The males in *maensariensis* have large compound eyes with three ocelli placed on the vertex between the compound eyes. There are probably two in the other species which are located cephalad of the compound eyes. They are wanting in *Newsteadia*. The caudal end of the abdomen bears a pencil of delicate glassy threads of wax.

The species and the genera in part are based upon the number, size, and form of the lamellae or plates attached to the dorsal and lateral aspects of the body. It is unfortunate that the number and form and arrangement of the various groupings of pilacerores which form these lamellae have been neglected and structures that are extremely fragile and easily broken have been used instead. It is difficult when the various descriptions are compared to determine just what is meant. No one has attempted to standardize the nomenclature. The following names are suggested for the plates. Care has been used in selecting these names so that

they could be applied to the groups of pilacerores when these are described and used for separating the species in place of the wax excreted from them.

The ovisac is formed by the continuous band of pilacerores which are located on the lateral portions of the ventral aspect. The two sides converge toward the caudal end of the abdomen until they meet and fuse. These plates may be known as the ventral plates and the pilacerores that excrete them as the ventral pilacerores. The cephalic end of the ovisac is formed by a transverse band of pilacerores located on the first abdominal sternum. Its cephalic margin is usually straight. This is why the ventral surface of the ovisac is generally smooth and not fluted. The transverse cephalic portion of the ovisac may be known as the transverse plate and the band of pilacerores excreting it as the transverse pilacerores. The two rows of plates located on the dorsal aspect adjacent to each other and the meson are the dorsal plates and the pilacerores that excrete them as the dorsal pilacerores. They are apparently the subdorsal keels of Tinsley, the subdorsal plates of Cockerell, and the dorsal or median lamellae of other writers. There are typically eleven pairs of dorsal plates, a row of eleven dorsal plates on each side of the meson. The cephalic or first pair of dorsal plates is formed by groups of pilacerores located upon the head and these may be known as the head plates or the head pilacerores. They vary greatly in size and shape and, when the two groups of pilacerores are continuous on the head, are sometimes represented by a single plate. The tenth and eleventh dorsal plates are usually very different in shape from those of the other segments. They frequently form semicircular plates which are continuous on the meson. The fusion of adjacent plates can be indicated by the use of the word plate instead of plates as when they are separate. The eleventh pair of dorsal plates is located on the seventh abdominal segment cephalad of the anal ring and they may be known as the preanal plates. The tenth pair of dorsal plates are located on the sixth abdominal segment and may be known as the paranal plates. The tube of wax surrounding the anus is not excreted by pilacerores but by the cerores of the anal ring. An examination of this wax will show that it is different in structure and appearance from that excreted from the pilacerores, as the wax of the dorsal plates. This tube of wax may be known as the anal plate.

A few species have plates of wax located on the meson between the dorsal plates. They are generally designated as the wedge-

shaped plates. These plates are apparently limited to the mesothorax, metathorax, and the first abdominal segment and may be known as the mesal plates.

There is a second series of plates which extend around each margin of the body and form the lateral plates of the test. These are the lateral plates or lateral pilacerores and are sometimes designated as the marginal plates, the circumferential lamellae, the lateral plates, or the lateral keels. There are ten lateral plates located on each side of the test. The first lateral plate of each side is formed by a group of pilacerores located on the prothorax. The other groups are located on the other thoracic segments and abdominal segments one to eight. The pilacerores forming the lateral plates are located on each lateral portion of their respective segment adjacent to the band forming the ovisac or the ventral plate. The abdominal spiracles of segments one to seven are located among the lateral pilacerores. The lateral pilacerores of the eighth segment are frequently continuous on the meson so that the pair of plates of this segment is usually represented by a single plate and in such cases it is frequently designated as the telson. It is located caudad of the anal plate and for this reason has been named the postanal plate. The plates formed by the groups of lateral pilacerores on segments five, six, and seven are frequently much larger and longer than any of the others and have been designated the caudal plates. They are also apparently the posterior lateral plates of some writers.

In a few species there is a longitudinal row of plates on each side between the mesal plates and the lateral plates. These have been named the intercalary plates. Newstead designated them the supplementary scales. In some descriptions the so called subdorsal keels or plates may be homologous with the intercalary plates.

The subfamily *Ortheziinae* contains six genera which can be separated by means of the following table:—

#### GENERA OF ORTHEZIINAE

- a. Antennae of adult female with seven to nine segments and of nymphal female with six segments; tibio-tarsal sutures of each leg distinct.
- b. Antennae of adult female with nine segments; head of adult male with three ocelli. -----*Douglasia* MacG.
- bb. Antennae of adult female with seven or eight segments and of nymphal female with six segments; head of adult female with two ocelli or ocelli wanting.
- c. Adult female without mesal plates. -----*Orthezia* Bosc.

- cc. Adult female with three or more mesal plates. *Arctorthezia* Ckll.
- aa. Antennae of the adult female with less than nine segments and of nymphal female of less than six segments.
  - b. Antennae of adult female with four or more segments and of nymphal female with four segments; tibio-tarsal suture of each leg wanting, so that claw appears to be continuous with tibia.
  - c. Antennae of adult female with six or seven segments and of nymphal females with four segments. -----*Neuestadia* Green.
  - cc. Antennae of adult female and of nymphal female with four segments. -----*Ortheziola* Sulc.
  - bb. Antennae of adult female and of nymphal female with three segments; tibio-tarsal suture of each leg wanting, but claws distinctly separated from tarsus. -----*Nipponorthezia* Kuw.

**Douglasia MacG.**—This genus includes a single species, *maenariensis* Douglas, from the Island of Montecristo, Italy on Erica. The head plates are small and not strongly projecting or divergent. The lateral plates are less than the typical number. Douglas figures the ovisac with ten longitudinal ridges.

**Orthezia Bosc.**—The great majority of the described species of this subfamily belong to the typical genus *Orthezia*. The species are difficult to recognize because of the different nomenclature used and the different value assigned the same characters by different authors. It is not unlikely that some of the species included in the following table have been misplaced for this reason. The table includes most of the American species. It is unsatisfactory, but may prove of value in the identification of specimens. In every case the specimens should be compared with the original description.

## SPECIES OF ORTHEZIA

- a. Dorsal surface of body of the adult female exposed between dorsal and lateral plates or caudad of dorsal plates or mesal and dorsal plates wanting; uncovered portion sometimes covered with mealy wax.
- b. Portion of dorsal surface of adult female not covered by plates of wax much greater in extent than covered area.
  - c. Dorsal surface of body of adult female completely exposed between lateral plates, dorsal plates entirely wanting; ovisac slightly longer than body; antennae consisting of eight segments.—Arizona on *Quercus*. -----*nuda* Ferris.
  - cc. Dorsal surface of body of adult female always with two rows of dorsal plates.
  - d. Body of adult female exposed as black mesal band between two rows of dorsal plates.
    - e. Dorsal plates much farther apart, more divergent on thorax and cephalic abdominal segments; dorsal plates subequal in length and thickness.—United States, Mexico, West Indies, British Guiana, Brazil, England, South Africa, Mauritius, Ceylon, China on *Coleus*, *Lantana*,



- Ipomoea, Thunbergia, Strobilanthus, Verbena, Achillea, Salvia, Cuphea, Capsicum, Ageratum, Veronia, Gardenia, Chrysanthemum, Lonicera, Citrus, tea, strawberry, tomato, etc. ----- *insignis* Dougl.
- ee. Dorsal plates arranged in practically straight rows, parallel, not divergent or farther apart on thorax, cephalic dorsal plates thicker and longer than caudal; dorsal surface of body naked except for two median rows of small dorsal plates and a little mealy powder.—New Mexico.-----  
*monticola* Ckll.
- dd. Body not exposed between two rows of dorsal plates; cephalic dorsal plates thicker and longer than caudal.—New Mexico on Gutierrezia. ----- *nigrocincta* Ckll.
- bb. Portion of dorsal surface of adult female not covered by plates of wax much less in extent than covered area.
- c. Portion of dorsal surface of body of adult female exposed limited to small portion caudad of dorsal plates; four large caudal plates project caudad over ovisac; postanal plate much abbreviated.—Mexico on Hymenoclea. ----- *sonorensis* Ckll.
- cc. Portions of dorsal surface of body of adult female exposed limited to narrow band-like areas between dorsal and lateral plates.
- d. Dorsal plates forming high, double, mesal crest of long erect white plates; two caudal plates of each side very long and curving down over sides of ovisac; body pale pea-green.—New Mexico on Garrya. ----- *garryae* Ckll.
- dd. Dorsal plates not forming high white mesal crest.
- e. Caudal plates of each side two or three times as long as other lateral plates and strongly divergent; head plates fused and projecting over head as strongly divergent projections.—Jamaica, Trinidad, British Guiana, Brazil on Capsicum, Croton, Citrus, Sanchezia. ---- *praelonga* Dougl.
- ee. Caudal plates of each side not greatly elongated and divergent; head plates not strongly divergent projections.
- f. Dorsal surface with deep mesal furrow between two rows of dorsal plates; head plates prolonged over head, not divergent or greatly produced; caudal plates subequal in length.—Argentine Republic on Compositae(?).  
*ultima* Ckll.
- ff. Dorsal surface not with deep mesal furrow between two rows of dorsal plates; head plates not prolonged over head; caudal plates longest; caudal dorsal plates widest; ovisac very long; antennae with third segment longest or third and eighth subequal.—New Mexico, California on grass. ----- *graminis* Ckll.
- aa. Dorsal surface of body not exposed, completely concealed by plates of wax.
- b. Dorsal surface not with row of intercalary plates on each side.

- c. Ovisac with eight longitudinal ridges.
- d. Antennae of adult female with eight segments.
  - e. Antennae with first segment subequal to second and first and second each shorter than third.
    - f. Dorsum with furrow; antennae with third segment slightly longer than second, first and second subequal; antennae and legs dark brown.—New Mexico, Arizona, Colorado on *Chenopodium*, *Atriplex*, *Kochia*. *annae* Ckll.
    - ff. Dorsum not with furrow; dorsal plates two to five directed cephalad, remaining dorsal plates successively smaller and directed caudad; antennae with third segment longest; antennae and legs dark red-brown.—New Mexico on *Artemisia*. ----- *artemisiae* Ckll.
  - ee. Antennae with first segment distinctly longer than second.
    - f. Antennae with segments one and three subequal and second segment about one-half their length, eighth segment longest; legs and antennae brown; wax compact.—Organ Mountains, New Mexico on *Cheilanthes*. ----- *cheilanthes* Tins.
    - ff. Antennae with second and third segments subequal and each shorter than first.—California on *Bahia*. ----- *californica* Ehr.
- dd. Antennae of adult female with seven segments, living in nests of ants.
  - e. Caudal plates very long, about two-thirds length of body, curving over ovisac but not attached to it; body orange color; antennae with seven segments.—New Mexico from the nests of *Lasius americanus*. ----- *lasiiorum* Ckll.
  - ee. Caudal plates longer than other lateral plates, not long and curving as long projections over ovisac.—Colorado from the nests of *Lasius*. ----- *olivacea* Ckll.
  - ce. Ovisac with ten longitudinal ridges; dorsal plates one to six successively longer and stouter, seven and eight much shorter.—Ohio, Illinois on *Solidago*. ----- *solidaginis* Sands.
- bb. Dorsal surface with row of intercalary plates on each side.
  - c. Ovisac short, postanal plates not fused and nearly as long as ovisac; caudal plates shorter than postanal plates.—Canada, New York, Iowa on *Solidago*, *Arctium*. ----- *americana* Walker.
  - ce. Ovisac long, five or more times as long as fused postanal plates; caudal plates nearly twice as long as postanal plates.—Europe on *Matricaria*, *Caltha*, *Teucrium*, *Achillea*, *Dodder*. ---- *urticae* Linn.

**Arctorthezia** Ckll.—This name was proposed by Cockerell for the two species of *Orthezia* provided with mesal plates. An examination of the mesal groups of pilacerores should offer distinctive characters for the recognition of the genus. The two species can be separated as follows:

## SPECIES OF ARCTORTHEZIA

- a. Mesal plates small and not extending beyond caudal margin of their segment and not overlapping mesal plates of next segment.—Greenland, Lapland, Norway, Scotland, England, Ireland from *Saxifraga*, grass. -----*cataphracta* Shaw.
- aa. Mesal plates large and extending beyond caudal margin of their segment and overlapping mesal plate of next segment.—Colorado, New Mexico from nests of ants. -----*occidentalis* Dougl.

**Newsteadia Green.**—This genus contains a single species, *floccosa* De Geer, found in British Isles, Germany, Bohemia, and Australia on grasses and sedges. There are seven mesal plates, of which the intermediate are the longest, and four lateral plates. The caudal lateral plates are fused to the ovisac. The Australian specimens were found upon some wet timbers in a mine at a depth of three hundred feet and were identified by Green. This species in common with some others is often collected among moss, lichens, and dead leaves and it is possible that they may feed upon the two former. Whether the species was introduced into Australia on the timbers is not known.

**Ortheziola Sulc.**—This genus contains three species, *fodiens* Giard from Guadeloupe on the roots of the coffee tree; *signoreti* Haller from France; and *vejdovskyi* Sulc from Prague from under leaves and moss. This latter species, the type, has the dorsal aspect completely covered with plates of wax.

**Nipponorthezia Kuwana.**—A single species, *ardisiae* Kuwana, from Japan on *Ardisia* is included. The dorsum is almost naked due to the small size of the dorsal plates. The third antennal segment is as long as the other two together. Each ocellana is located distant from the articulation of an antenna which is unusual.

## CHAPTER XII

### SUBFAMILY PHENACOLEACHINAE

#### *The Ringeyed Coccids*

The body of the adult female is convex on the dorsal aspect and flat on the ventral. It is elongate elliptical in outline with the cephalic end bluntly rounded and the caudal end bluntly pointed. The caudal end of the body is not inflated and the cephalic and lateral margins are not provided with a keel. The segments are well defined. The antennae are prominent, consisting of eleven segments, and are articulated to the ventral aspect of the head near each lateral margin. The eyes are not described. The mouth-parts, rostrum and rostralis, are always present, the rostrum consists of three distinct segments. The legs are present. They are subequal in length and normal in form. The profemora are never enlarged and the prothoracic legs are never fitted for digging. The trochantro-femoral and tibio-tarsal sutures of all the legs are probably distinct. The thoracic and abdominal spiracles are not definitely described and not figured. The stigmatic clefts, spinae, and canellae are wanting. The abdomen is about as long as the head and thorax together. It is convex on the dorsal aspect, never depressed. The lateral margins converge slightly caudad and the caudal end is bluntly pointed. All the segments are fully exposed and similar in appearance with distinct coriae between them, none are retracted to form a marsupium. The abdomen is never provided with an anal cleft and opercula or anal lobes and anal setae. The anal ring is always distinct and provided with six prominent anal ring setae. The caudal abdominal segment is never short and narrow, extending beyond the other segments. The body is provided with cerores, none of which are octacerores or pilacerores and is never provided with ceratubae. The body is never enclosed in a resinous cell with three adjacent openings or covered by a scale with or without exuviae, but is covered with white mealy wax among which is mixed some curling cottony threads of wax. The rectum is never provided with a long glassy tube of wax or with a chitinized rectal tube bearing one or more rings of anacerores. The body is never naked and gall-like in form.

The female nymphs of all stages, so far as known, are provided with a rostrum and rostralis. The three pairs of legs are present in all nymphal stages and are similar in form. The profemora are never greatly enlarged and the prothoracic legs are never fitted for digging. The body is never provided with an anal cleft and opercula, anal lobes and anal setae, octacerores, pilacerores, or ceratubae. The anal ring is distinct and bears six anal ring setae. The caudal end of the rectum is not chitinized, forming a rectal tube provided with one or more rings

of anacerores excreting a long glassy tube. The caudal abdominal segment is not short, narrow, and projecting.

The male has eight ocellanae on each side of the head, forming an almost complete circle, and two distinct ocelli. The abdomen is not provided with long lateral filaments, but the caudal end bears on each side of the meson a bundle of four to six rather long setae and a very long thick thread-like filament of wax. The wings are sometimes greatly reduced. The stylus is inconspicuous.

This subfamily contains a single genus, *Phenacoleachia*, based upon a species described by Maskell from New Zealand. There is but little known regarding the life-history of the species. Maskell describes the adult female, the first nymphal stage, and the adult male. The species resembles closely many species of *Pseudococcus* in its general habits and general appearance.

The adult female is eight millimeters or less in length, the two ends of the body are rounded, and the caudal end lacks all indication of anal lobes and anal setae. These structures are characteristic of most species provided with a prominent anal ring and anal ring setae but are not characteristic features of this one. The antennae are long and consist of eleven segments. The body is covered with mealy and cottony wax, some of the latter form long curling coarse yellowish threads. Some of the caudal abdominal segments bear small porrect pencils of wax which give the insect the general appearance of a mealy-bug.

The nymphs are similar to the adults but smaller. They are similarly covered with wax and bear about the same number, five or six, pencils or lateral projections of wax. The antennae consist of seven segments. The rostrum is elongate and, as in the adult, consists of three segments. Those species provided with an anal ring and lacking anal lobes in the adult, generally have large prominent anal lobes in the nymphal stages, particularly the first, but there are no indication of such structures in the nymphs of this species.

The adult males are about two millimeters long and rather densely covered with white mealy wax. The eyes are represented by eight ocellanae on each side and, except for a small space on the meson of the dorsal and ventral aspects, form almost a complete ring about the head. There is on each side of the meson of the dorsal aspect caudad of the ocellanae two other simple eyes which are considered as ocelli. The antennae consist of ten segments. The legs are long and slender. The caudal end of the abdomen bears two long, slender, thread-like filaments of wax. The wings, while normally large and prominent and held in place by halteres

with two hooks, are sometimes so rudimentary that the insect is almost apterous.

This insect is of great interest. The eleven segmented antennae of the adult female and the lack of anal lobes and anal setae marks it as a generalized species while the well developed anal ring shows a relationship with the anal ring conservers. The number of simple eyes in the male, their arrangement, and the presence of ocelli would suggest that this is a stage in the transformation of compound eyes to groups of simple eyes. The males of all the preceding subfamilies but one, the Coccinae, have compound eyes. Most of these also have a well developed ocellus caudad of each compound eye. It may be assumed that all the facets of each compound eye of Phenacoleachia have been lost except those forming a half of the ring of each side. The facets of the compound eyes where they are present are usually large and not closely associated. It is easy to understand how the various types with a varying number of ocellanae of the other subfamilies have been developed from a condition such as is found in Phenacoleachia. The reduction has proceeded in all females until there is only a single ocellana present on each side of the head. The fact that in certain if not all wingless males, there is only a single ocellana on each side, might lead one to assume that a larger number was not needed in order to locate the females.

**Phenacoleachia Ckll.**—There is a single species in this subfamily, *Phenacoleachia zealandica* Maskell from New Zealand, where it occurs upon *Podocarpus*, *Cupressus*, and *Fagus*. This species was referred to the genus *Leachia* by Maskell and later transferred to *Palaeococcus* which is another name for the same group by Cockerell who erected in 1899 the present generic name, *Phenacoleachia*.

## CHAPTER XIII

### SUBFAMILY ERIOCOCCINAE

#### *The Mealy Bugs*

The body of the adult female varies from convex to subrotund, the sides from convex to subparallel. It is elongate or short oval in outline with the two ends bluntly pointed or bluntly rounded. The segmentation is usually well defined. The caudal end of the body is not inflated and the cephalic and lateral margins are not provided with a keel. The antennae are prominent, consist of five to nine segments, and are articulated to the ventral aspect of the head near each lateral margin or they are rudimentary or wanting. The eyes are usually present, when present, they are inconspicuous fuscous spots, a single ocellana located on each lateral margin near the articulation of an antenna. The mouthparts, rostrum and rostralis, are always present, the rostrum usually consists of two distinct segments, rarely only one. The legs are typically present. They may be rudimentary or wanting, if present, they are subequal in length and normal in form. The profemora are never enlarged, if enlarged, all the other femora are enlarged. The prothoracic legs are never fitted for digging. The trochantro-femoral and the tibio-tarsal sutures of all normally formed legs are always distinct. The spiracles of the mesothorax and metathorax are normal in size and form and ventral in position. The mesothoracic spiracles are never located near the anus. The abdominal spiracles are always wanting. The stigmatic clefts, spinae, and canellae are wanting. The abdomen is normally about as long as the head and thorax together. It is subconvex on the dorsal aspect and flat on the ventral aspect, sometimes thin and disk-like, approaching a depressed condition. The lateral margins are nearly straight and subparallel or strongly convergent and convex, the caudal end is bluntly pointed or bluntly rounded or almost truncate. All of the segments are fully exposed and similar in appearance with distinct coriae between them, none are retracted to form a marsupium. The abdomen is never provided with an anal cleft and opercula. There is typically a distinct anal ring provided with four, six, eight, or more anal ring setae, anal ring and anal setae sometimes wanting. The anal lobes are usually distinct and bear anal setae. The caudal abdominal segment is never short and narrow and extending beyond the other segments, the caudal segments at least are campanulate. The body is provided with cerones none of which are octacerones or pilacerones and is never provided with ceratubae. The body is never enclosed in a resinous cell with three adjacent openings or covered by a scale with or without exuviae, but is generally completely covered with powdery or mealy wax, sometimes with masses of cottony or woolly threads of wax, often found on or within a mass of rather compact cottony threads of wax

among which the eggs are placed. The rectum is never provided with a long glassy tube of wax or with a chitinized rectal tube bearing rings of anacerores. The body is never naked and gall-like in form.

The female nymphs of all stages are provided with a rostrum and rostralis. The three pairs of legs are present in the first nymphal stage and generally in the other nymphal stages, sometimes greatly reduced or wanting, when present, are usually similar in form. The profemora are never greatly enlarged and the prothoracic legs are never fitted for digging. The caudal end of the rectum is not chitinized, forming a rectal tube provided with one or more rings of anacerores excreting a long glassy tube of wax. The body is never provided with an anal cleft and opercula or pilacerores and rarely with octacerores or ceratubae. The anal ring is distinct and provided with four to eight or more anal ring setae, usually six, and frequently different in number from that of the adult. The anal lobes are usually distinct and provided with anal setae. The caudal abdominal segment is not short, narrow, and projecting.

The male has ocellanae. The abdomen is not provided with lateral filaments or with tufts of long slender glassy threads of wax, but is usually provided with two or four long slender caudal threads of wax. Wings are sometimes wanting. The stylus is short and inconspicuous.

This subfamily contains some of the best known species of the family, the species of *Pseudococcus*, generally known as Mealy Bugs. This name comes from the fact that their bodies, dorsal and ventral aspects, are generally densely covered with a fine granular wax which gives them the appearance of having been rolled in coarse flour. Several of the species are of great economic importance in subtropical and tropical regions where they are able to pass the winter out of doors. In temperate regions where the winters are generally rigorous, they are found in the main only in glass houses where they are often serious pests unless held in check by frequent fumigations.

The females are active throughout their entire or almost their entire life and in all nymphal stages, cover their bodies with mealy wax, so that they appear conspicuous against the green surface of the plant. They are prone to congregate together, so that they assemble, usually from two to six, in the angle between two branches or in the angle between a leaf and a branch. The adult females form the mass of wax, the so called ovisac, in which the eggs, 150 to 200 in the case of *Pseudococcus citri*, are deposited. These are usually placed in the angles between the stems or a leaf. The eggs hatch in ten to eighteen days, but of the eggs deposited only a small number produce males. The young nymphs remain in the ovisac for a short time, but on leaving spread rapidly over various parts of the plant and settle along the midrib and in the angles in the stems.



The segmentation of the body is distinct and is usually made clearer by the covering of mealy wax. The antennae are articulated to the ventral aspect of the head and the single ocellana on each side shows prominently on the ventral surface through the presence of black pigment. The female molts three times and passes through three nymphal stages. The females are very similar in all the stages, the only striking difference between them is that of size. Even this is not constant for there is considerable variation in the size of different individuals even of the same age or stage. There is also a variation, as in other coccids, in the number of antennal segments present in individuals of the various stages.

It is impossible to differentiate the males from the females during the first nymphal stage, except in mounted specimens that have almost completed the first nymphal stage. Berlese has pointed out that in such individuals, the mandibles and maxillae of the second stage of the female can be identified before those of the first stage are shed. They can be observed coiled spirally on each side of the meson beneath the cuticle of the body. Since the males lose their rostralis at the first molt in most if not all species of this subfamily, there is no such spirally coiled rostralis to be observed under the cuticle in this sex.

The nymphs of the male molt four times in *Pseudococcus citri* and pass through four nymphal stages. The male nymphs are sluggish and seek some secluded spot where they spin a cocoon of felted threads of wax. The second molt occurs soon after the completion of the cocoon and the cast skins are pushed out of the end of the cocoon. The eyes of the adult male are simple, six ocellanae, a pair of comparatively large ones on the dorsal aspect, a similar pair on the ventral aspect, and one on each lateral aspect which are about one-half the size of the others. They are sometimes designated as the primitive eyes and are considered as representing the ocellanae present in the first nymphal stage. The supposition being that they have been retained through all the nymphal stages although not identifiable in the latter ones. They are also considered as ocelli and the large facets in such cases are designated as eyes. The number of ocellanae varies in the males of other genera than *Pseudococcus*, that is, there is more than six. Writers are careless about stating the number in most cases. The wingless males of *Fonsecolombia* have retained only the lateral ocellanae. Whether the wingless males of other groups have only the lateral ocellanae is not known. The wing-pads and developing

legs and antennae of the male appear after the second molt. The antennae and legs of the nymph are lost at the first molt. The adult males are minute fragile creatures with delicate wings. The halteres are small and provided with hooks. The males of Fonscolombia are always wingless and the males of a few other genera are sometimes wingless.

The wax excreted by the female on different parts of the body appears from a cursory examination to be identical. A careful examination will show, however, that there are several different types. An unpublished study of the cerores of *Pseudococcus citri* and the wax they excrete was made in 1907 under my directions by Robert Matheson, he found that there were several distinct types, four or more, and that the wax excreted from each of these types was of a different kind, but the difference could be determined only in most cases after a careful microscopical examination of the wax. The predominant type of ceroris in this species is the diamond-shaped cerores with numerous openings. These have been named the tricerores. While they are of general occurrence on all parts of the dorsal and lateral aspects, they are usually more numerous upon the anal lobes and form the pencils or projections of wax attached to the anal lobes. These pencils are not confined to the anal lobes but in many species there is a row of them along each lateral margin of the body. The lateral pencils are excreted by groups of tricerores like those of the anal lobes. The porrect form of the pencils is due to the presence of one or more short conical setae. The number varies not only with the segment but with the species. The setae are typical in form and frequently are as broad as long. They are usually associated with the tricerores and support the pencils of wax. Berlese named these groups of tricerores and conical setae filiere. They are also known as cerari, cerarii, and filuri. There are eighteen pairs of cerari on each side of the body in the common greenhouse *Pseudococcus*, which must take the name of destructor Comstock, while there are only seventeen in *citri* according to Berlese, Marchal, and Ferris. The cerari of destructor are arranged, four on the head, only three in *citri*, two on each thoracic segment and one on each of the eight abdominal segments. The cerari of the anal lobes, the eighteenth pair, as they are generally counted, are larger than those on the other segments of the body. These cerari are known as the anal cerari and all the others as the lateral cerari. If necessary those of the head, thorax, and abdomen can be distinguished as the head

cerari, thoracic cerari, and abdominal cerari. There may be two rows of cerari on the dorsal aspect between the lateral cerari, the dorsal cerari, and if a single dorsal row should be present, they could be known as the mesal cerari. The setae of the cerari are not always short and conical, but may be long and slender like the other setae in certain species. There are often ordinary setae associated with the cerari, named the auxiliary setae by Ferris to distinguish them from the conical setae of the cerari, the ceraran setae. The ordinary setae of the dorsal aspect are known as the dorsal setae. The number of ceraran setae varies from two to twenty, the largest number so far observed. If there is a variation in number between the various cerari, there is likely to be a larger number in the first six cerari or in the anal cerari. The cerari are sometimes obscure in the adult female, probably due to the swelling of the body by the eggs, but are generally very distinct in the half grown nymphs. In certain genera, as *Antonia*, the cerari are wanting; are represented by only a few in others, as *Trionymus*, where only the anal cerari are present in some species, while others may have four pairs; or there may be a considerable number of pairs as in many species of *Pseudococcus*. The number varies from a single pair to as many as twenty-four pairs in *Macrocerococcus* as figured by Leonardi.

Marechal and Ferris have described some minute cylinders which are connected with the external cuticle of the body-wall. Each is represented as having one side of the distal end continued as a much smaller cylinder. These cuticular cylinders are considered as the outlets of wax cells, which are circular in outline. The number in *destructor* seems to be variable. I have found them more often along the margin of the body near the anal lobes. Some species seem to show them in considerable number. They are regarded as *ceratubae*.

The ventral aspect of the abdomen of the female bears the numerous ceriores from which the cottony threads of wax in which the female conceals herself and her eggs. These ceriores are peculiar to the adult female, are typical in form, and like the *genaceriores* do not appear until after the last molt.

Berlese has called attention to the presence of four peculiar structures located on the dorsal aspect which he designates as the *foveola labiate*. There is two of them on the head and two in the *coria* between the sixth and seventh abdominal segments. These

structures may be known as the labiae, those on the head as the cephalabiae and those on the abdomen as the caudalabiae. They are also known as the eye-like glands, cicatrices, fossette ostioloform labiate, and dorsal ostioles. The labiae were considered by Berlese as places where the cuticle had been invaginated for the attachment of muscles. They are lip-like structures. The sides or infolded surfaces of the lips or labiae bear setae and cerotres. The caudalabiae are generally longer than the cephalabiae, the latter are sometimes greatly reduced and wanting. Between the lips of the labiae there appears to be the mouth of invaginated pockets. There can frequently be observed on living specimens a small globule of a clear fluid over the mouth of each labia, more frequently the caudalabiae than the cephalabiae, so that they are probably also glandular in structure as suggested by Comstock. For, as he suggested, when the specimens are stroked with a pencil or dissecting needle, the insect will hump up its back and extrude a globule of liquid. The insect is unable to repeat this operation until the pocket is again filled with the clear fluid. Specimens have been observed to extrude globules from all four labiae at the same time. The labiae undoubtedly have a glandular function which is probably of later origin than their earlier function, a paradigm for the attachment of muscles. Sule, who has made a histological study of these structures, believes that the globules of sticky matter rolled in wax are for defensive purposes. When they come into contact with antennae or palpi of the enemy, as he states, these appendages are all stuck up and unserviceable until they have been cleaned. This fact together with the belief that the excretion is derived from the fat tissue, has led Sule to name these structures the "adiopugnatorische organ."

There is another labia on the ventral aspect of the abdomen between the second and third segments, the ventralabia. This has not been observed to extrude any globules. Sule has also made a careful study of this structure. He considers this labia as entirely different in origin and structure from the cephalabiae and caudalabiae. His published figures support his contention as to their structure. He considers, I believe erroneously, this structure as homologous with the stink glands of the adult heteropterous Hemiptera. He also calls attention to a rudimentary structure in the first abdominal segment which does not show in specimens

cleared in caustic potash. The ventralabia is not an invaginated pocket like the other labiae.

The ventral aspect of the head frequently bears about eight setae located between and caudad of the articulation of the antennae. These setae are known as the interantennal setae. They can usually be identified from the other setae of this region by their greater size and the regularity of their arrangement.

The mesothoracic and metathoracic spiracles are located in the transverse furrows marking the position of the mesocoria and metacoria. They appear in mounted specimens as hour-glass-shaped structures. One end of each spiracle is smaller than the other, is located in the cuticle of the body-wall, and contains a small opening. This opening is the spiracle. The round plate of cuticle which surrounds the spiracle is the peritreme. The remainder of the hour-glass-shaped or funnel-shaped structure is a modification of the spiracular trachea, although the entire structure is generally figured and described as a spiracle. The flaring structure or modification of the spiracular trachea is a cavera. The abdominal spiracles are always wanting.

The claws, while generally simple, in a few genera bear a single tooth near the middle of their ventral aspect. This is the "denticle of the face of the claw" of Ferris. There is also some variation in the number and form of the digitules borne by the claws.

The anal ring and the anal ring setae are typically present in the adult female. When absent, they are present in the nymphal stages or at least in the first nymphal stage. The normal number of anal ring setae is six judging from the large number of genera that have this number and also from the fact that those genera without, with less than, or with more than six in the adult female often have six in the first nymphal stage. The number varies from two to fifty or more, but is never apparently an odd number. The anal ring setae can be differentiated as the cephalic, median, and caudal when there are only six present. The cephalic anal ring setae are those on the cephalic or dorsal portion of the anal ring, depending upon the position of the ring. The anal ring is usually more or less vertical in position, but may be dorsal, as is frequently the case with the anus in the coccids. The closed end of the anal ring in *Pseudococcus* which is the dorsal side, if

the ring is vertical, is considered as the cephalic end and the opposite end as the caudal. The anal ring bears cerores, which are arranged in two rows in *Pseudococcus*, the orbacerores, and judging from their staining reaction are different in structure. The outer and shorter row is the lateral orbacerores, the inner and mesal row is the mesal orbacerores. This latter is frequently continuous between the cephalic anal ring setae. Some of the cerores of the mesal row in this genus are elongated and produce extensions of or irregularities in the membrane surrounding the anus. These cerores may be known as the dentacerores. They were called denticulate pores by Smith, who was the first to call attention to them. The number of dentacerores on each side of the anal ring is not large, so far as observed two to four. It is difficult to make good flat preparations showing the characteristic number and arrangement of the orbacerores, dentacerores, and anal ring setae, but my observations lead me to believe that some of the best characters for the differentiation of species are to be found in these structures. The importance of these characters was first emphasized by P. E. Smith. Flat preparations for the study of these structures can be secured only by dissecting out the anal ring and mounting it separately. The anal lobes should be removed and the dissecting should be done on a slide after the specimens have been stained and cleared.

There are in certain genera four prominent setae located caudad or ventrad or cephalad of the caudal end of the anal ring, depending upon whether the anal ring is dorsal, caudal or vertical, or partially ventral. These setae are known as the cisanal and obanal setae. They mark the four corners of a quadrangular area. The two setae nearest to the anal ring are the longest and are known as the cisanal setae. These are the cephalic postanal setae of Smith. The two setae farthest from the anal ring are generally smaller than the cisanal setae and are frequently located farther apart. They are obanal setae, the caudal postanal setae of Smith.

The species of this subfamily are frequently based upon the comparative length of the antennal segments. Kellogg and Bell and later P. E. Smith made careful studies and measurements of antennae of specimens of unquestioned identity and showed that characters of this sort were worthless for the separation of species. Their studies went to show that there was enough variation in the length of the segments of the two antennae of the same individual

to make different species of them. While Smith has shown of how little value most of the comparative characters used in separating species are, he has called attention to the use of several new structural characters, as the cephalabiae and caudalabiae which were first figured by Berlese, the cerari and the number of conical setae contained in each which had been previously used by Marchal unbeknown to Smith, the cisanal and obanal setae, the cerores of the anal ring and their arrangement in rows, the difference in the form and extent of the two rows, and the dentacerores of the mesal row. It has also been noted by Matheson that in the case of *Pseudococcus citri* that there is a great variation in the size of the adult females when they commence laying their eggs, as he states, "often what I, judging from the size only, considered were nymphs in the third stage would prove to be mature females and commence egg laying." This is undoubtedly true of many if not most other species of coccids.

The subfamily *Eriococcinae* includes two groups of genera which are easily distinguished in the first nymphal stage. In one group the dorsum bears rows of blunt conical setae and in the other the dorsum bears fine pointed setae. This latter group clearly includes the generalized genera and has been designated as a tribe by Cockerell under the name *Daetylopiini*. The group with the rows of blunt dorsal setae is clearly the specialized end of the series, genera in which the ordinary pointed setae have become changed in form and acquired a symmetrical arrangement and have been designated as a tribe by the same author under the name of *Eriococcini*. Whether these two groups of genera represent distinct subfamilies as the form and arrangement of the setae of the body might suggest, is not clear. Our knowledge of the anatomy of the adult female is very imperfect. What is needed in this subfamily is not the description of more new species and genera, but a careful study of the anatomy of the described forms and an extended search for additional characters upon which their classification and their phylogeny can be based.

The following table to the genera is based in great part upon descriptions and is faulty not only in construction but undoubtedly in the characters used. Where a difference in number of antennal segments is shown, specimens should be traced through both sides of the table. I have egg laying females of what I believe are undoubtedly species of *Phenacoccus* with less than nine segments

in the antennae. It is hoped that it will save at least the repeated reading of a large number of descriptions. The arrangement of the genera placed after the table is that of the table. It is not intended to show anything as to the relationship of the genera.

# GENERA OF ERIOCOCCINAE

- a. Thorax of adult female with three pairs of normal legs.
- b. Insects not producing or living in galls upon plants.
- c. Anal ring bearing six anal ring setae in at least some stage of development of insect.
- d. Anal ring bearing six anal ring setae in all stages, nymphs and adult.
- e. Antennae of adult female with less than nine segments.
- f. Antennae consisting of eight segments.
- g. Body of insect oval in outline, subdepressed, enclosed in cottony wax but not in cottony sac of wax; body not bearing numerous short conical setae.
- h. Body with lateral margins not produced into series of blunt tubercles, each bearing cerarus.
- i. Adult female with lateral margins of body convex, body about twice as long as wide; nymphs of male with antennae consisting of six segments; abdomen with labiae and usually with more than four pairs of cerari. -----  
*Pseudococcus* Westw.
- ii. Adult female with lateral margins of body straight and subparallel, about three times as long as wide; nymphs of male with antennae consisting of eight segments; abdomen with labiae and never with more than four pairs of cerari; antennae of adult female sometimes consisting of seven segments. *Trionymus* Berg.
- hh. Body with lateral margins produced into series of prominent blunt tubercles, each bearing cerarus; cephalabiae and caudalabiae present.  
*Tylococcus* Newst.
- gg. Body of insect circular in outline, globular or subglobular, without lateral cottony tufts and enclosed wholly or in part in cottony sac of wax; body bearing short conical setae and with only anal cerari present. -----*Erium* Maskell.
- ff. Antennae consisting of less than eight segments.
- g. Adult female not enclosed in shining black scale with caudal orifice.
- h. Anal lobes not strongly chitinized with blunt spine-like projections at distal end.



- i. Cuticle of adult female not with numerous conical setae that are as broad as long.
- j. Body not circular in outline; legs not greatly swollen and enlarged.
- k. Anal ring retracted and surrounded by irregular outer chitinous ring or plate which supports on each side prominent tubercle bearing several stout setae; antenna of adult female consisting of seven segments.  
*Lefroyia* Green.
- kk. Anal ring not retracted and surrounded by outer chitinous ring supporting tubercles with prominent setae; antennae of adult female usually with less than seven segments.
- l. Antennae of adult female always with more than three segments.
- m. Distance on the ventral aspect of head between antacoriae distinctly less than length of two proximal segments of antennae.
- n. Antennae of the adult female with five or six segments, not geniculate; distal segment nearly as long as other segments together.-----  
*Ripersiclla* Ckll.
- nn. Antennae of adult female with five segments; antennae geniculate.----  
*Rhizococcus* Kunck.
- mm. Distance on ventral aspect of head between antacoriae equal to or greater than length of two proximal segments of antennae.
- n. Cephalic pair of anal ring setae of adult female nearer together or at most only slightly farther apart than caudal pair; cuticle of female nymphs not provided with rows of blunt setae.
- o. Antennae of adult female with six segments, rarely five or seven; cerari wanting or only anal cerari present; ceraran setae setiform, not conical. -----  
*Ripersia* Sign.
- oo. Antennae of adult female with six segments; anal cerari only present; ceraran setae setiform.  
*Cryptoripersia* Ckll.

- nn. Cephalic pair of anal ring setae of adult female twice as far apart as caudal pair; cuticle of female nymphs provided with rows of blunt setae; antennae of adult female consisting of six segments; body without labiae.....  
*Fonscolombia* Fonse.
- ll. Antennae of adult female consisting of three segments; femora with distal portion dilated; tarsal claws large, entire, scarcely arcuate, armed; presence of six anal ring setae not certain.....  
*Termitococcus* Silv.
- jj. Body circular in outline; legs short and stout, femora greatly swollen, radiating from periphery of the body; abdomen shorter than distance between two caudal pairs of legs; antennae of adult female consisting of six segments. ....*Pseudoripersia* Ckll.
- ii. Cuticle of adult female with numerous conical setae that are about as broad as long; anal ring crescentic in outline with anal ring setae located on convex side; antennae of adult female with seven segments. *Gymnococcus* Dougl.
- hh. Anal lobes strongly chitinated with blunt spine-like projection at distal end, making them appear segmented; anal ring circular; antennae of adult female with six segments; cuticle with conspicuous irregularly arranged cerores in groups of three. ....*Geococcus* Green.
- gg. Adult female enclosed in shining black scale with caudal orifice; antennae of adult female consisting of six segments; anal lobes not much produced.....  
*Porococcus* Ckll.
- ee. Antennae of adult female consisting of nine segments.
- f. Body of adult female covered with mealy or granular wax, wax frequently forming pencils but never fused to form plates or lamellae.
- g. Abdomen with glistening discs on ventral aspect of first three abdominal segments, probably marking position of labiae. ....*Coccurea* Sule.
- gg. Abdomen not with glistening discs on ventral aspect of first three abdominal segments, even if with ventralabiae, not with them on first three abdominal segments.
- h. Adult female with simple claws, not toothed.
- i. Body with twenty-four pairs of cerari and six

- dorsal longitudinal rows of cerari-like structures. -----*Macrocerococcus* Leon.
- ii. Body with fourteen pairs of cerari and without dorsal longitudinal rows of cerari-like structures. -----*Macrocepicoccus* Morr.
- hh. Adult female with claws distinctly toothed; body at most only rarely with more than eighteen pairs of cerari.
- i. Adult female provided with large cerores surrounded by three short spine-like setae, cerores opening in short processes which are arranged in longitudinal rows; each ceroris excreting a long glassy thread of wax.-----*Heticoccus* Sule.
- ii. Adult female not provided with large cerores surrounded by three spine-like setae opening in projections arranged in longitudinal rows.
- j. Adult female with tricerores and round cerores; antennae of adult female consisting of eight or nine segments, usually nine; body usually with eighteen pairs of cerores.-----  
*Phenacoccus* Ckll.
- jj. Adult female with round cerores only; antennae of adult female consisting of nine segments; body with only two pairs of cerores, these located at the caudal end of abdomen.--  
*Heterococcus* Ferris.
- ff. Body of adult female not covered with mealy or granular wax, but with wax fused to form plates or lamellae; antennae of adult female consisting of nine segments; claws of adult female with tooth; body usually with eighteen pairs of cerari. -----*Ceroputo* Sule.
- dd. Anal ring of first stage nymphs with six anal ring setae and of adult female with more or less than six anal ring setae.
- e. Anal ring of adult female with two minute anal ring setae.  
*Ehrhornia* Ferris.
- cc. Anal ring of adult female with twenty-four to thirty anal ring setae. -----*Trabutina* Marchal.
- cc. Anal ring bearing eight or more anal ring setae.
- d. Anal ring bearing eight anal ring setae.
- c. Antennae of adult female with nine segments; tarsal claws with tooth at middle; body of first stage nymphs not with row of blunt dorsal setae. -----*Puto* Sign.
- ee. Antennae of adult female with less than nine segments; tarsal claws simple, not with tooth; body of first stage nymphs with rows of blunt dorsal tubercles.
- f. Body of adult female naked; antennae of adult female consisting of seven segments. -----*Rhizococcus* Sign.

- ff. Body of adult female not naked, covered at least in part by wax.
  - g. Body of adult female uniformly covered with mealy or granular wax, never with lateral tufts of cottony lamellae-like wax; antennae of adult female with six or seven segments. -----*Ericoccus* Targ.
  - gg. Body of adult female with the dorsal aspect naked, but lateral aspects with prominent erect tufts of cottony wax resembling lamellae or plates; antennae of adult female with six segments. ----*Gossyparia* Sign.
- dd. Anal ring always bearing more than eight anal ring setae.
  - e. Antennae of adult female consisting of seven segments; anal ring of adult female with twenty to twenty-four anal ring setae. -----*Lachnoidius* Mask.
  - ee. Antennae of adult female always with less than seven segments.
    - f. Antennae of adult female consisting of six segments; anal ring of adult female with fifty or more anal ring setae. -----*Lachnodiella* Hemp.
  - ff. Antennae of adult female consisting of three segments; anal ring of adult female with twelve anal ring setae. -----*Micrococcus* Leon.
- bb. Insects producing or living in galls upon plants.
  - c. Antennae and legs normal in size and form, not rudimentary.
    - d. Antennae of adult female consisting of seven segments; anal ring of adult female with anal ring setae; galls subglobular swellings at the base of leaf.-----*Atriplicia* Ckll. & Rohw.
    - dd. Antennae of adult female consisting of six segments; anal ring of adult female without anal ring setae; galls formed on both sides of leaf; anus guarded by four sharp setae.-----*Tectococcus* Hempel.
  - cc. Antennae and legs rudimentary; antennae of nymphs of first stage consisting of six segments; anal ring with long setae; galls cup-shaped and growing upon branches.-----*Cissococcus* Ckll.
- aa. Thorax of adult female not with three pairs of normal legs, some or all of them greatly reduced or wanting.
  - b. Anal ring of adult female always with anal ring setae.
    - c. Anal ring of adult female and of first stage nymph always with six or less anal ring setae.
    - d. Anal ring of adult female and first stage nymph with six anal ring setae.
    - e. Abdomen never with ventral cribiform plate caudad of each metaspiracle.
      - f. Nymphs of first stage not with rows of dorsal setae; adult female with stub-like vestigial antennae, usually

consisting of three segments and without legs; rostrum not located on prominent protuberance.

g. Abdomen of adult female sometimes with the caudal end more or less invaginated, forming anal tube with anal ring with six large anal ring setae; first stage nymph with antennae consisting of six segments and anal ring with six anal ring setae.

h. Adult female and first nymphal stage with caudalabiae; adult female enclosed in tough cottony ovisac from which projects small tube of wax.-----

*Antonia* Sign.

hh. Adult female without caudalabiae and first nymphal stage with cephalabiae and caudalabiae; last nymphal stage of female with legs; adult female enclosed between small scales, clothing base of long pointed gall.-----*Sphacrococcus* Mask.

gg. Abdomen of adult female with caudal end not invaginated to form anal tube; anal ring with six small anal ring setae; first stage nymph with antennae consisting of six segments and with anal ring with six slender anal ring setae; body apparently without cephalabiae and caudalabiae; adult female enclosed under sheathing base of host plant.-----

*Paludicoccus* Ferris.

ff. Nymphs of first stage with rows of dorsal setae; adult female with antennae rudimentary, consisting of three segments, and without legs; rostrum borne by prominent cephalic prolongation; antennae of first stage nymph consisting of six segments.-----*Nidularia* Targ.

ee. Abdomen with circular cribiform plate on ventral aspect caudad of each metaspiracle; antennae of adult female consisting of one segment and of first stage nymph consisting of three segments; adult female without legs.-----

*Kawanina* Ckll.

dd. Anal ring of adult female and of first stage nymph with four short spine-like setae; antennae of adult female vestigial, consisting of about four segments; metathoracic legs vestigial, others wanting; antennae of first stage nymph consisting of five segments; body without labiae.-----

*Cryptococcus* Dougl.

cc. Anal ring of adult female and of first stage nymph with seventeen anal ring setae; abdomen with prominent tubercle caudad of each metaspiracle; antennae and legs of adult female wanting; nymphs of first stage with antennae consisting of seven segments. -----*Kermicus* Newst.

bb. Anal ring of adult female described as without anal ring setae; antennae of adult female vestigial, segmentation difficult to identify, about three segments, legs always wanting; antennae of first nymphal stage consisting of six segments, anal tubercles small

and inconspicuous; anal ring of female nymphs with six anal ring setae. -----*Chactococcus* Mask.

**Pseudococcus Westw.**—This is the largest genus of the subfamily. Over one-half of the described species, one hundred or more, have been reported from America. The species are as a rule very poorly differentiated and difficult to identify. The most of them have been based upon the comparative length of the antennal segments, characters which have been shown several times to be absolutely worthless. The only published study of a considerable number of species of any value is that of Ferris. He has made use of the cerari, characters first noted by Marchal and Smith independently. It is unfortunate that Ferris did not make use of the cerores of the anal ring and the setae associated with them. Credit is due Smith for the accuracy of his observations on the anal ring as all his work was based upon unstained specimens. The following table, although differently arranged, is based upon the work of Ferris, supplemented where possible by that of Smith. There are the following American species not included in the table:—*aphyllonis* Ckll. from District of Columbia on *Aphyllon*; *azaleae* Tins. from California on *Azalea*; *brevipes* Ckll. from Jamaica on pineapple; *bromeliae* Bouche from India, South Africa, Zanzibar, South America, Massachusetts on Mulberry, Canna, Hibiscum, pineapple; *claviger* King & Tins. from Massachusetts from the nests of *Lasius*; *cockerelli* King & Tins. from Massachusetts from nests of ants; *eualatensis* Ckll. from Mexico; *dasyliirii* Ckll. from New Mexico on *Dasyliirion*; *filamentosus* Ckll. from South Caicos Island, Jamaica, Mauritius, Hawaiian Islands, Japan; *fornicarii* Ehrh. from Arizona on roots of *Artemesia*; *grandis* Hemp. from Brazil on *Myrtaceae*; *hymenocleae* Ckll. from Arizona on *Hymenoclea*; *iceryoides* Mask. from New Zealand, Australia, California on *Fagus*; *ledi* Ckll. from New York on *Ledum*; *liliacearum* Bouche from South America on *Liliaceae*; *magnolieida* King from Brazil; *mamillariae* Bouche from France, Central America on *Mamillaria*, *Cactus*; *mendozinus* Leon. from Argentina on *Hyalis*; *missionum* Ckll. from Argentina; *neomexicanus* Tins. from New Mexico on *Gutierrezia*; *olivaceus* Ckll. from Mexico on *Yucca*; *pseudonipiae* Ckll. from Massachusetts, Michigan, California, Mexico on *Coccoloba*; *perceorsus* Leon. from Argentina on *Gourliea*; *phoradendri* Ckll. from Arizona in hollow stems of *Phoradendron* attended by *Cremastogaster*; *quaintanell* Tins. from Florida on *Rhus*; *roseotinctus* T. & W. Ckll. from New Mexico on roots of grass; *sacchari* Ckll. from Trinidad, Barbadoes, Porto Rico, Mauritius, Mexico on Sugar-cane; *secretus* Hemp. from Brazil on *Solenaceae*; *segregatus* Ckll. from Jamaica on grass; *setosus* Hemp. from Brazil on *Ficus*; *simplex* Ckll. from Jamaica on *Pancratium*, "Liliaceous plants;" *solani* Ckll. from New Mexico on potato; *subterraneus* Hemp. from Argentina on roots of grape; *texensis* Tins. from Texas on *Acacia*; *townsendi* Ckll. from New Mexico; *tuliparum* Bouche from South America; *virgatus* Ckll. from Jamaica, Mexico, Texas, Mauritius, Hawaiian Islands on *Acalypha*, violets, cotton, cocoanut-palm, cactus; and *wheeleri* King from Texas from nests of *Campanotus*.

## SPECIES OF PSEUDOCOCCUS

- a. Anal cerari with ten or more ceraran setae.
- b. Body with seventeen pairs of cerari, anal cerari with fifteen to twenty ceraran setae, other cerari with three to six ceraran setae; anal ring with single dentaceroris on each side; cisanal setae adjacent to anal ring, distance between them subequal to distance between obanal setae.—California on Ramona, Artemisia, Quercus, Pasania, Adenostoma. ----- *crawii* Coq.
- bb. Body with not more than eleven pairs of cerari, anal cerari with fifteen to twenty ceraran setae, first pair of cerari cephalad of anal cerari with six to ten ceraran setae, other cerari with two to four ceraran setae.—California on Ephedra. ----- *ephedrae* Coq.
- aa. Anal cerari never with more than two ceraran setae.
- b. Cerari other than anal cerari never with more than two ceraran setae.
- c. Body always with eighteen pairs of cerari; ceraran setae usually two in number, rarely with one or two of cephalic cerari with three or four ceraran setae.—Eastern United States on Coleus, ferns, various greenhouse plants. ----- *destructor* Comst.
- cc. Body always with less than eighteen cerari.
- d. Body always with at least seventeen pairs of cerari.
- e. Anal cerari never placed on well defined chitinized area.
- f. Ceraran setae of usual conical form, never with distal portion of shaft or with distal portion of shaft of dorsal setae flagelliform; cerari without auxiliary setae, ceraran setae large; dorsal setae small and scattered; anal ring setae shorter than anal setae; anal ring with two dentacerores on each side; the cisanal setae distinctly closer together than obanal setae.—Europe, United States, Jamaica, Brazil, Hawaiian Islands, Mauritius on orange, lemon, coffee, tobacco, ivy, peony, coleus, and many other plants. ----- *citri* Risso.
- ff. Ceraran seate with distal portion of shaft flagelliform; dorsal setae numerous, elongate, with dorsal portion more or less flagelliform; cerari without auxiliary setae; anal setae about one and one-half times as long as anal ring setae.—Japan, California, New Jersey on Krauhnia. ----- *krauhniae* Kwn.
- ee. Anal cerari always placed on well chitinized area; ceraran setae not with distal portion flagelliform; dorsal setae numerous, long; anal cerari and adjacent one or two pairs of lateral cerari with auxiliary setae, other cerari without; anal setae and anal ring setae subequal.—California on Distichlis. ----- *timberlakei* Ckll.
- dd. Body always with less than seventeen pairs of cerari.
- e. Body with twelve to fifteen pairs of cerari; ceraran setae short and stout, those of lateral cerari distant, more distant than those of anal cerari; auxiliary setae wanting,

also groups of tricerores; anal setae slightly shorter than anal ring setae. This statement of characters is based upon the work of Ferris. One of my students who has examined specimens of nipae and what we believe to be pseudonipae has found characters showing these two species to be not only well but easily differentiated species.—British Guiana, Mexico, Massachusetts, Indiana, Michigan, California on *Nipa*, palms.-----*nipa* Mask.

- ee. Body with five to six pairs of cerari present on five or six caudal segments; anal cerari on indefinite chitinated area bearing two or three slender auxiliary setae and few tricerores; dorsal setae small and few in number; anal setae subequal to anal ring setae.—Australia, New Zealand, Natal, California on *Araucaria*, *Dammara*.-----*aurilatus* Mask.
- bb. Cerari other than the anal cerari, at least cephalic pair, always with more than two ceraran setae.
- c. Body always with more than twelve pairs of cerari.
  - d. Body with cephalic six or seven pairs of cerari with each cerarus with three or four ceraran setae; body with seventeen pairs of cerari; lateral cerari with three or four auxiliary setae; anal cerari borne on chitinated plate; dorsal setae numerous and rather long; anal setae equal to or slightly longer than anal ring setae.—Japan, New York, California on Mulberry, maple, Pinus. -----*comstocki* Kwn.
  - dd. Body with the cephalic three or four pairs and sixth pair of cerari with each cerarus with three or four ceraran setae.
  - e. Anal cerari not borne by distinct more strongly chitinated area.
  - f. Cerari without auxiliary setae.
    - g. Anal cerari with tricerores numerous, twenty-five or more, immediately about their ceraran setae.
    - h. Body with fifteen to seventeen pairs of cerari, cephalic two or three pairs of cerari with each cerarus with three ceraran setae, other cerari with two; tricerores about six in number about lateral cerari, but few on body; anal setae and anal ring setae subequal.—California on Cupressus, Thuja, Libocedrus, Sequoia.-----*ryani* Coq.
    - hh. Body with seventeen pairs of cerari, cephalic four pairs of cerari with each cerarus with three or four ceraran setae, other cerari with two; tricerores about twelve to fifteen on cephalic and caudal cerari, always more than six, fairly numerous on the body; anal setae two-thirds length of anal ring setae, latter distinctly longer than diameter of anal ring; ventral surface of anal lobes chitinated.—Illinois, Massachusetts on sorghum, corn, nests of *Lasius*.---*sorghivellus* Forbes.



- gg. Anal cerari with tricerores always few in number, twelve or less, about their ceraran setae.
- h. Body with seventeen pairs of cerari, cephalic three or four pairs of cerari with each cerarus with three ceraran setae, other cerari with two; anal lobes with three or four slender setae; dorsal setae few, very small; anal setae somewhat shorter than anal ring setae.—California on Sequoia, Cupressus. -----*sequoiae* Coleman.
- hh. Body with less than seventeen pairs of cerari.
- i. Body with sixteen pairs of cerari, cephalic three or four pairs of cerari with each cerarus with three or four ceraran setae, other cerari with two.
- j. Ceraran setae of cephalic pair of head cerari located close together, less than their own length apart; dorsal setae few, small and slender; anal ring setae scarcely longer than width of anal ring and about one-half length of anal setae.—Arizona on Covillea.-----*irishi* Ckll.
- jj. Ceraran setae of cephalic pair of head cerari distant, located their own length or more apart; dorsal setae few, small, and slender; anal ring setae scarcely longer than width of anal ring and about one-half length of anal setae.—New Mexico on Covillea.-----*stectii* Ckll. & Towns.
- ii. Body with fifteen pairs of cerari, cephalic two or three pairs of cerari with each cerarus with four or five ceraran setae, other cerari with two; ceraran setae small and widely separated; dorsal setae few, extremely few and slender; anal ring setae somewhat longer than width of anal ring and subequal in length to anal setae.—Arizona on Juniperus.-----*juniperi* Ehrh.
- ff. Cerari with auxiliary setae.
- g. Anal cerari with tricerores always few in number, not forming crowded area about their ceraran setae; body with fifteen to seventeen pairs of cerari, typically seventeen; cephalic three or four pairs of cerari with each cerarus with three conical setae; other cerari with two; all cerari with prominent auxiliary setae; dorsal setae numerous and usually long; anal setae and anal ring setae subequal.—California on Castilleja, Oribanche, Armeria.-----*longisetosus* Ferris.
- gg. Anal cerari with numerous tricerores crowded into a circular area about the ceraran setae; body with

seventeen pairs of cerari; cephalic two or three and sixth pairs of cerari with each cerarus with three or four ceraran setae, other cerari with two; all cerari with numerous auxiliary setae; dorsal setae few and slender; anal setae shorter and more slender than anal ring setae; anal ring with single dentaceroris on each side; mesal orbacerores forming irregular double row between cephalic anal ring setae; cisanal setae farther apart than obanal setae.—California, Oregon, Missouri, New York on tomato, carnation, passion flower, maple, clover, cherry, *Eriogonum*, *Quercus*, *Magnolia*, *Crataegus*, *Pinus*.-----

*maritimus* Ehrh.

- ee. Anal cerari borne by distinct more strongly chitinized area.
- f. Penultimate pair of cerari never borne on more strongly chitinized areas; body with seventeen pairs of cerari, cephalic three or four pairs of cerari with each cerarus with three or four ceraran setae, other cerari with two; lateral cerari with auxiliary setae; dorsal setae few and slender; anal setae and anal ring setae subequal; anal ring with single dentaceroris on each side; lateral orbacerores forming irregular double row between median and caudal anal ring setae; cisanal setae distant from anal ring and closer together than obanal setae.—California on *Passania*, *Quercus*.-----*agrifoliae* Essig.
- ff. Penultimate pair of cerari always borne on more strongly chitinized areas.
  - g. Anal cerari with their tricerores arranged in compact group about anal ceraran setae; body with seventeen pairs of cerari; cephalic three or four pairs of cerari with each cerarus with three or four ceraran setae, other cerari with two; all cerari with auxiliary setae; dorsal setae few and slender; anal setae shorter than anal ring setae; anal ring with two or three dentacerores on each side; cisanal setae adjacent to anal ring and farther apart than obanal setae.—*Pseudococcus longispinus* Targ.—United States, Jamaica, Chili, Europe, Mauritius, New Zealand on ferns, mango, guava, fig, plum, Citrus, Croton, Cycas, *Flacourtia*, *Nephrodium*, *Stangeria*.-----*adonidum* Linn.
  - gg. Anal cerari with their tricerores scattered, not arranged in compact group about anal ceraran setae; body with seventeen pairs of cerari; cephalic three or four pairs of cerari with each cerarus with three ceraran setae, other cerari with two; dorsal setae few and scattered; lateral cerari with auxiliary setae; anal setae and anal ring setae subequal.—California on Citrus, Azalea, Rubus, *Hedera*, *Ficus*,

Malva, Brassica, Solanum, Shinus, Chenopodium,  
Rheum, Rosa, Melilotus, Helianthus, Juglans, etc.-----  
*citrophilus* Claussen.

cc. Body always with less than twelve pairs of cerari.

d. Body with eleven pairs of cerari.

e. Cerari arranged as follows: pair cephalad of eyes, pair near eyes, pair opposite prothoracic legs, pair opposite mesothoracic spiracles, and seven pairs on abdomen, cephalic and thoracic pairs sometimes wanting; each cerarus usually with two ceraran setae; anal setae and anal ring setae subequal.—California on Cupressus.-----  
*cupressicolus* Ferris.

ee. Cerari arranged as follows: four pairs on head and seven pairs on abdomen; two cephalic pairs of cerari with each cerarus with three ceraran setae, other cerari with two; auxiliary setae associated with ultimate and penultimate pairs of cerari only; dorsal setae few and small; anal ring slightly chitinated; anal setae about one-half length of anal ring setae.—California on Distichlis.-----*salinus* Ckll.

dd. Body always with less than eleven pairs of cerari.

e. Body with eight or nine pairs of cerari counting cephalad from anal cerari and usually with pair cephalad of eyes; cephalic pair on head with several ceraran setae, other cerari with two; anal cerari with auxiliary setae, lateral cerari without; dorsal setae numerous, slender; anal setae about twice as long as anal ring setae.—California on Eriogonum, Viola, Stachys, Eriodictyon, Ceanothus, Eriogon. -----*eriogoni* Ehrh.

ee. Body with ten pairs of cerari.

f. Anal ring setae about equal in length to anal setae and about one and one-half times as long as width of anal ring; head with only ocular cerari, which contain three or four ceraran setae, other cerari with two; auxiliary setae present only among the anal cerari; dorsal setae few and small.—New Mexico, Utah, California on Gutierrezia. -----*gutierreziae* Ckll.

ff. Anal ring setae somewhat shorter than anal setae; anal setae about one and one-half times as long as width of anal ring; head with only ocular cerari, which contain three or four ceraran setae, other cerari with two; anal cerari only with auxiliary setae; dorsal setae small and few in number.—New Mexico, Arizona on Prosopis.-----  
*prosopidis* Ckll.

<sup>1</sup> *Trionymus* Berg.—This genus contains only two species according to Fernald's Catalogue, *perrisii* Sign. from France, the type, and a second species, *americanus* Ckll. from the District of Columbia. Ferris has prepared a synopsis of the Californian species. It is possible that several of the species now referred to *Pseudococcus* belong here. The following table is based upon the work of Ferris:—

## SPECIES OF TRIONYMUS

- a. Body never with more than single pair of cerari, anal cerari.
  - b. Anal cerari with their ceraran setae elongate and longer than dorsal setae, never short and conical; antennae of adult female consisting of seven segments; anal cerari with two or three auxiliary setae; anal ring not strongly chitinized; anal setae slightly shorter than anal ring setae.—California on *Distichlis*.....  
*distichlii* Ferris.
  - bb. Anal cerari with their ceraran setae short and conical, usually shorter than body setae.
  - c. Anal cerari with numerous tricerores grouped about their ceraran setae, distance between them subequal to or less than length of diameter of calices of ceraran setae.
  - d. Setae varying in size from small and slender to quite large and stout, those on each lateral portion of eighth segment subequal in diameter at proximal end to ceraran setae; antennae of adult female consisting of seven segments; anal cerari with two or three ceraran setae and several slender auxiliary setae; anal setae somewhat more slender and smaller than anal ring setae.—California on *Grindelia*.....  
*grindeliae* Ferris
  - dd. Setae not varying in size, all very short and slender, subequal, those on lateral portions of eighth segment never subequal in diameter at proximal end to ceraran setae, always slender; antennae of adult female consisting of seven segments; anal cerari with two ceraran setae and five to eight auxiliary setae; anal setae slightly shorter than anal ring setae.—Eastern United States on clover.....*trifolii* Forbes.
- cc. Anal cerari with only few tricerores and always distant, distance between them always twice or more than length of diameter of calices of ceraran setae.
  - d. Anal ring setae scarcely more than one-half length of anal setae; antennae of adult female consisting of seven segments.
  - e. Body with dorsum with relatively few cerores and cylindrical ducts, none of ducts short, broad, and tubular; abdomen with two caudal segments with many short, slender, curved setae, other segments with few.—California on *Elymus*.....*smithii* Esig.
  - ee. Body with dorsum with few, scattered, small, slender setae and numerous tricerores and short, broad, tubular ducts with a narrow raised rim; abdomen with two caudal segments not with many curved setae.—California on *Quercus*.....*villosa* Ehrh.
  - dd. Anal ring setae subequal in length to anal setae; antennae of adult female consisting of eight segments; anal cerari with two ceraran setae and two or three auxiliary setae; dorsal setae few, short, slender, curved; anal ring small and

heavily chitinized.—California on *Bromus*, *Ammophila*, *Ericameria*. -----*bromii* Ferris.

aa. Body always with more than one pair of cerari.

b. Anal cerari always situated upon distinct chitinized area bearing numerous tricerores and auxiliary setae; antennae of adult female consisting of eight segments; abdomen with two to four cerari at caudal end, ceraran setae of anal cerari large and stout, of other segments smaller; anal cerari surrounded by numerous tricerores and eight to ten auxiliary setae; anal ring setae slightly longer than anal setae.—California on *Elymus*. -----*californicus* Ehrh.

bb. Anal cerari never situated on chitinized area.

c. Body with three pairs of cerari, located at caudal end; ceraran setae all short and cylindrical, those of anal cerari largest; antennae of adult female consisting of eight segments; anal setae distinctly longer than anal ring setae.—France on *Calamagrostis*, *Sphagnum*, *Agropyrum*, *Festuca*.-----*perrisii* Sign.

cc. Body with two pairs of cerari located at caudal end of body.

d. Antennae of adult female consisting of eight segments; ceraran setae short, stout, conical, not accompanied by grouped tricerores or auxiliary setae; dorsal setae numerous, short, subequal; anal ring large and heavily chitinized; anal setae slightly longer than anal ring setae.—Australia, California on *Calceolaria*, *Danthonia*, *Phormium*, *Cordyline*, sugar-cane. -----*calceolariae* Mask.

dd. Antennae of adult female consisting of seven segments; ceraran setae small, conical, two in each cerarus; cerari not with grouped tricerores or auxiliary setae; dorsal setae short, more numerous on caudal part of body; anal ring small and strongly chitinized; anal setae slightly shorter than anal ring setae.—California on *Festuca*. -----*festucae* Kwn.

**Tylococcus** Newst.—This genus was based upon a single species, *madagascariensis* Newst., from Madagascar from the nests of *Cremastogaster*. The body is provided with cephalabiae and caudalabiae and with fifteen pairs of cerari. It is questionable if the other species referred to this genus by Brain belong to it.

**Erium** Mask.—A genus containing five species. The type, *globosum* Mask., is from Australia on *Acacia*. All the other species are from America, they are: *armatum* Hemp. from Brazil; *erigonii* Ehrh. from California on *Eriogonum*; *lichtensioides* Ckll. from Colorado, California on *Artemisia*; and *zapotlanum* Ckll. from Mexico on "Huele de Noche." Ferris has referred *irishii* Ckll. and *steelii* Ckll. & Towns. to *Pseudococcus*. He describes *lichtensioides* Ckll. as follows: antennae consisting of seven segments, anal cerari only present, consisting of ten ceraran setae borne on a chitinized area without auxiliary setae; dorsum of thorax and abdomen with numerous short conical setae, similar to the ceraran setae.

**Lefroyia** Green.—A single species, *castaneae* Green from Assam, India on *Castanea*, is included.

**Ripersiella** Ckll.—This generic name was first published by Cock-

erell and should be credited to him. The type species, *rumicis* Maskell is from New Zealand on *Rumex*. The other species are *kelloggi* Ehrh. & Ckll. from California on roots of bunch grass; *leucosoma* Ckll. from New Mexico from the nests of *Lasius*; and *maritima* Ckll. from Long Island, New York on roots of *Spartina*.

**Natalensia Brain.**—This genus is based upon a single species, *fulleri* Brain from Natal from roots of grass from nests of ants. By the table this genus will run to *Ripersiella* Ckll. The circular form of the body, the antennae consisting of six segments, and the anal ring bearing six anal ring setae in nymphal and adult females, are characteristic. The adult female is enclosed in a double-walled cyst without openings.

**Rhizoecus Kunck.**—An European genus of four species: *cloti* Giard from roots of coffee-tree; *falcifer* Kunck. from roots of palms and vines; (?) *targionii* Ckll. on *Mammillaria*; and (?) *terrestris* Newm. on roots of *Stephanotis*.

**Ripersia Sign.**—This genus is of indefinite limits. The following American species have been referred to it: *aurantia* Ckll. from New Mexico from nests of *Lasius*; *blanchardii* King & Ckll. from Massachusetts from nests of *Lasius*; *cockerellae* King from New Mexico from nests of *Lasius*; *flabiatula* Ckll. & King from New Mexico from nests of *Lasius*; *flaveola* Ckll. from Massachusetts, New Mexico from nests of *Lasius*; *kingii* Ckll. from Massachusetts from the nests of ants; *lasii* Ckll. from Canada, Massachusetts on roots of asters and from the nests of ants; *magna* T. & W. Ckll. from New Mexico; *minima* Tins. & King from Massachusetts from nests of *Lasius*; *myrmecophila* Mask. from Michigan; *porterae* Ckll. from New Mexico on the roots of grass; *salmonacea* Ckll. from New Mexico on roots of grass; *serrata* Tins. from Trinidad; *sporoboli* Ckll. from New Mexico on *Sporobolus*; *tenuipes* Ckll. from New Mexico on the roots of grass; *trichura* Ckll. from New Mexico from the roots of grass; *trivittata* Ckll. from New Mexico from nests of *Lasius*; *villosa* Ehrh. from California on *Quercus*; and *viridula* Ckll. from New Mexico from nests of *Lasius*.

**Cryptoripersia Ckll.**—Two species have been referred to this genus, *Eriococcus salinus* Ehrh. from California on *Distichlis* and *Ripersia arizonensis* Ehrh. from Arizona, California on *Elymus*. Ferris has examined the types of both species and has pronounced them identical.

**Fonscolombia Fonsc.**—There are two European species: *fraxini* Kalt. on *Fraxinus* and *radicum-graminia* Fonsc., the type, on roots of grass and grain and two American species: *braggi* Ckll. & Robs. from Colorado on *Berberis* and *yuccae* Ferris from New Mexico on *Yucca*. In *yuccae* there are numerous cereres in the region of the vulva which are wanting in *braggi*.

**Termiticoccus Silv.**—Two species, *aster* Silv. from Paraguay and *bicornis* Silv. from Brazil, collected in the nests of termites, not from ant's nests as recorded in Fernald's Catalogue, belong to this genus.

**Pseudoripersia Ckll.**—A genus including a single species, *turgipes* Mask. from Australia on *Casuarina*.

**Gymnococcus Dougl.**—The type of this genus is *agavium* Dougl. from Europe. The genus contains two American species found upon grass, *nativus* Parr. from Kansas and *ruber* Parr. & Ckll. from New

Mexico. These species can be separated by the following table prepared by Parrott. It should be noted that the American species will not run to *Gymnococcus* in the table to the genera of *Eriococcinae*.

SPECIES OF *GYMNOCOCCUS*

- a. Cuticle of adult female with numerous short conical setae.—Europe on Agave. ----- *agavium* Dougl.
- aa. Cuticle of adult female not bearing conical setae.
  - b. Thoracic spiracles with cerores forming complete ring about them.—New Mexico on grass. ----- *ruber* Parr. & Ckll.
  - bb. Thoracic spiracles with cerores limited to one side, not forming complete ring about spiracle.—Kansas on grass. ----- *nativus* Parr.

**Geococcus Green.**—A single species, radicum Green from Ceylon upon the roots of grass, is included.

**Porococcus Ckll.**—There are two species from Mexico included, occurring on mistletoe on oak; pergandei Ckll. and tinctorius Ckll.

**Coccurea Sulc.**—A genus erected for *Phenacoccus comari* Künow from Germany on Comarum by Sulc. Ferris believes that the American *Phenacoccus stachyos* Ehrh. is congeneric.

**Macrocerococcus Leon.**—This genus includes a single species, superbus Leon. from Italy, Corsica, and France on *Lepidum*, *Alyssum*, *Iotus*, *Fumaria*, *Cetarach*, *Antirrhinum*, and undetermined grass.

**Macroceplococcus Morr.**—A single species, *loranthi* Morr., the type of the genus, described from British Guiana. The cerari consist of a chitinated area bearing from one to four ceraran setae.

**Tetrura Licht.**—This genus is omitted from the table. The description of the genus and species is too indefinite to permit of its location. It would run to *Phenacoccus* by the table. There is a single species, *rubi* Licht. from Europe on *Rubus*.

**Hellococcus Sulc.**—A single species included, *bohemicus* Sulc from Bohemia and Moravia on *Robinia*.

**Phenacoccus Ckll.**—There are thirty-four species referred to this genus in Fernald's Catalogue. Of this number sixteen are recorded from America, some of these have since the publication of the Catalogue been referred to the synonymy. The following species, other than those included in the table, should be noted. They are: *americanæ* King & Ckll. from Massachusetts from the nests of *Lasius*; *cevalliae* Ckll. from New Mexico on *Cevallia*; *cockerelli* King from Colorado on *Amelanchier*; *gossypii* Towns. & Ckll. from Mexico on cotton, other *Malvaceae*, wild guava; *minimus* Tins. from Colorado on *Picea*; *rubivorum* Ckll. from New Mexico on *Rubus*; *ripersioides* W. & T. Ckll. from New Mexico from nests of *Lasius*; *simplex* King from California on *Atriplex*; *solenopsis* Tins. from New Mexico from nests of *Solenopsis*; *spiniferus* Hemp. from Brazil; and *wilmattae* Ckll. from New Mexico on *Viola*.

SPECIES OF *PHENACOCCLUS*.

- a. Body with many short, stout, cylindrical ducts.—California on lichens on *Picea*. ----- *kuwanae* Coleman.
- aa. Body not with many short, stout, cylindrical ducts.
  - b. Anal cerari with only two ceraran setae.

- c. Head cerari and all other cerari of body never with more than two ceraran setae.
- dd. Body with eighteen pairs of cerari; auxiliary setae wanting; triceroroes few and scattered; anal lobes sometimes with single seta, sometimes with two or three small setae in addition to ceraran setae; dorsal setae small, sharply pointed; anal setae about one and one-half times as long as the anal ring setae; antennae consisting of eight segments.—California, Utah on roots of Hemizoonia, potato, tomato, wild radish, Malva, pansies, wild sunflower, aster, nightshades, purslane. ----- *solani* Ferris.
- dd. Body with fifteen or sixteen pairs of cerari; cerari with small but distinct clusters of triceroroes and without auxiliary setae; ceraran setae large, subequal in size, stout, conical, with distal portion slightly flagellate; antennae consisting of six to eight segments; anal ring setae about twice as long as diameter of anal ring and much longer than anal setae.—*Pseudococcus lycii* Ferris.—Arizona on *Lycium*. ----- *lycii* Ferris.
- cc. Head cerari, at least one pair, with three to four ceraran setae.
- d. Anal setae slightly shorter than anal ring setae; cephalic three or four pairs of cerari with three or four ceraran setae, other cerari with two, all cerari obscure and without auxiliary setae; dorsal setae minute and few in number; tubular ducts few, without raised rim.—California on *Artemisia*. ----- *artemisiac* Ehrh.
- dd. Anal setae about one and one-half times as long as anal ring setae; ocular cerari with three to four ceraran setae, other cerari with two, all without auxiliary setae; anal lobes large and prominent; dorsal setae few and extremely small; tubular ducts with their mouths borne at apical end of conical projections, projections surrounded by one to four small setae; tubular ducts arranged two to three near each cerarus, irregular double row near the meson, and indefinite number on head.—*Phenacoccus osborni* Sanders.—*Phenacoccus pettiti* Hollinger.—California, Ohio, Missouri on *Stachys*, *Monardella*, *Diplacus*, *Solanum*, *Toxicodendron*, *Catalpa*, *Sycamore*. ----- *stachyos* Ehrh.
- bb. Anal cerari always with more than two ceraran setae.
- c. Anal cerari with three or four ceraran setae, also cephalic three or four pairs of cerari, all other cerari with two ceraran setae; cerari without auxiliary setae; body setae few, scattered, and small; anal setae nearly twice as long as anal ring setae.—California on *Rubus*, *Fragaria*, *Symphoricarpos*, *Castilleja*, *Eriophyllum*, *Geranium*. ----- *colmani* Ehrh.
- cc. Anal cerari always with more than four ceraran setae.
- d. Anal setae nearly twice as long as anal ring setae; anal cerari with six to ten ceraran setae, second pair from caudal end with six to ten, third with two and several other setae



scattered about, all other cerari with two; cerari with auxiliary setae; dorsal setae shaped like ceraran setae and as large as smallest of them; anal ring setae longer than diameter of anal ring.—*Phenacoccus betheli* Ckll.—Canada, Michigan, Illinois, Arizona on *Amelanchier*, *Crataegus*. ----

*dearnessi* King.

dd. Anal setae and anal ring setae subequal, former never twice as long as latter.

e. Anal cerari with about ten ceraran setae, all other cerari with three to six, these setae slender and sharply pointed; cerari without auxiliary setae; triceroroes of cerari few, scarcely exceeding setae in number; dorsal setae almost lacking and extremely minute; anal setae equal to or trifle shorter than anal ring setae.—California on *Eriogonum*. ----

*erigoni* Ferris.

ee. Anal cerari with ten or more ceraran setae and numerous scattered triceroroes; penultimate pair of cerari with five to eight ceraran setae and numerous triceroroes; cephalic two or three pairs of cerari with four to six ceraran setae and eight to ten triceroroes; all other cerari with two ceraran setae and cluster of eight to ten triceroroes; cerari without auxiliary setae; dorsal setae few, small, in part slender and in part like ceraran setae; anal ring setae somewhat longer than diameter of anal ring and about equal in length to anal setae.—New Mexico, Arizona, California on *Helianthus*, *Pluchea*, *Solanum*, *Baccharis*, *Ptiloria*. ---- *helianthi* Ckll.

**Heterococcus Ferris.**—A genus containing a single species, *arenae* Ferris from California on *Poa*.

**Ceroputo Sulc.**—The type of this genus is *pilosellus* Sulc from Europe. The other species are from America, as follows: *ambigua* Fullaway from California on *Salicornia*; *bahiae* Ehrh. from California on *Bahia*; *barberi* Ckll. from Antigua, New Mexico on *Thunbergia*, *Allamanda*, *Coleus*, *Croton*; *calictectus* Ckll. from New Mexico on grass; *koebelet* Ehrh. from Arizona on *Quercus*; *lassiorum* Ckll. from New Mexico from nests of *Lasius*; *orthezloides* Ckll. from Mexico on roots of dockweed; *yuccae* Coq. from Antigua, Mexico, California on *Yucca*, *Lantana*, *Mimulus*, *Ceanothus*, banana, orange, lime, etc. Ferris writes as follows on this genus: "I consider *Ceroputo* to be strictly a synonym of *Puto*. The former was separated from the latter solely on the basis of the presence of but six hairs on the anal ring and of non-clubbed digitules."

**Ehrhornia Ferris.**—This genus contains two species, *cupressi* Ehrh. on *Cupressus* and *graminis* Ferris on grass. Both species are from California.

**Trabutina Marchal.**—A single species is included, *elastica* Marchal from Algeria on *Tamarix*.

**Puto Sign.**—The type of the genus is *antennata* Sign. from France on pine. There is a described American species, the *Pseudococcus* cu-

pressi Coleman from California on Cupressus, Pinus, Torreya, and Sequoia.

**Rhizococcus Sign.**—This genus includes about twelve described species, one from France, gnidii Sign. on roots of Daphne, is the type; one from Texas, texanus King from the nests of Crematogaster; and all the other species are from the Australian region.

**Eriococcus Targ.**—This genus contains over sixty species. The following have been recorded from America: adenostomae Ehrh. from California on Adenostoma; araucariae Mask. from New Zealand, Ceylon, Hawaiian Islands, South Africa, California on Araucaria, Kunzea; arenosus Ckll. from New Mexico; armatus Hemp. from Brazil on Baccharis; artemisiae Knw. from California on Artemisia; aurescens Ckll. from Mexico on "Guasima;" azaleae Comst. from Massachusetts, New York, District of Columbia, Ohio, Indiana, Michigan on Azalea, Crataegus, Rhododendron; bahiae Ehrh. from California on Bahia, Gutierrezia; borealis Ckll. from Alaska on willow; brasiliensis Ckll. from Brazil on Baccharis; catalinae Ehrh. from California on Artemisia; coccineus Ckll. from Nebraska on Cactus; diversispinus Leon. from Argentina on Zaccagnia; dubius Ckll. from Mexico; eriogoni Ehrh. from Arizona on Eriogonum; gilletti Tins. from Colorado on Juniperus; howardi Ehrh. from California on Quercus; kemptoni Parr. from Kansas on Andropogon; larreae Parr. & Ckll. from New Mexico on Larrea; multispinosus Kuhlitz from South America on Cactus; neglectus Ckll. from New Mexico on Atriplex; palmeri Ckll. from Carmen Island, Lower California on Bourreria, Eriogonum; parvispinosus Leon. from Argentina on Atriplex; perplexus Hemp. from Brazil on Myrtaceae; quercus Comst. from Massachusetts, Florida, New Mexico, Arizona, Mexico on Quercus, gallberry, Vaccinium, Prosopis, grass; salinus Ehrh. from California on Distichlis; and tinsleyi Ckll. from New Mexico on Atriplex, Malvastrum, Gutierrezia.

**Gossyparia Sign.**—This genus contains five species, three from the Australian region and two from Europe. One of these latter, spuria Modeer on elm, has been introduced into the United States.

**Lachnodioides Mask.**—A genus containing three described species from Australia on Eucalyptus and Acacia.

**Lachnodiella Hempel.**—A single species, cecropiae Hempel from Brazil on Cecropia, is included. The name of this genus and species was first offered in print by von Ihering, but no description of either was given by this author.

**Micrococcus Leon.**—A single species, silvestri Leon. from Sardinia from the nests of Tapinoma, is included.

**Atriplicia Ckll. & Rohw.**—A genus of gall making eriococcids containing a single species, gallicola Ckll. & Rohw. from New Mexico and Colorado on Atriplex.

**Tectococcus Hemp.**—There is a single species, ovatus Hempel from Brazil on Myrtaceae.

**Cissococcus Ckll.**—A single species, fulleri Ckll. from South Africa on Cissus is included. Ehrhorn has referred oahuensis Ehrh. from the Hawaiian Islands on Urera doubtfully to this genus.

**Antonia Sign.**—The American species of this genus can be separated by means of the following table:—

## SPECIES OF ANTONIA

- a. Anal ring located at cephalic end of invaginated anal tube; antennae of adult female consisting of three segments; caudal end of abdomen usually strongly chitinated.
- b. Abdomen with caudal end not strongly chitinated or not decidedly more strongly chitinated than adjacent parts; adult female about three times as long as broad; metathoracic spiracles located near middle of length of body, mesothoracic spiracles midway between metathoracic spiracles and antennae, and rostrum midway between mesothoracic spiracles and antennae; spiracles with group of about twenty-five closely placed cerores adjacent to their lateral margin; anal lobes wanting; caudal end of body on each side of anal tube with three long setae.—England on recently imported plants of *Arundinaria japonica*. ----- *socialis* Newst.
- bb. Abdomen with caudal end strongly chitinated on ventral or both dorsal and ventral aspects.
  - c. Adult female, untreated, oval in form and cream-colored; caudal portion of abdomen strongly chitinated on ventral aspect and dark in color; abdomen on caudal segments bearing numerous small slender setae; spiracles surrounded on lateral margin by crescentic-shaped group of cerores; first stage nymph with transverse row of short conical setae on middle of each segment.—Kansas on *Bouteloua*. ----- *boutelouae* Parr.
  - cc. Adult female, untreated, oval or circular in outline and deep purplish-red in color; caudal portion of abdomen quite heavily chitinated and bearing numerous short, spine-like setae, other portions of body with only few setae at margin, first stage nymphs with group of two or three short setae at lateral margin of each of three last abdominal segments.—Japan, California on bamboo. ----- *crawii* Ckll.
- aa. Anal ring not located at cephalic end of invaginated anal tube; antennae consisting of three to five segments; caudal end of abdomen not strongly chitinated.
  - b. Antennae short, with four or five segments, the two proximal segments are usually about the same width and distal segments taper sharply; prothoracic legs sometimes present; body with few short setae, more numerous on caudal portion; spiracles with crescentic group of about forty closely placed cerores, situated near lateral margin of spiracle.—Kansas on *Eragrostis*, *Bulbilis*, *Paspalum*. ----- *parrotti* Ckll.
  - bb. Antennae aborted, never with more than three segments.
    - c. Body, exclusive of caudal segment, bearing large number of setae; spiracles colored and accompanied by abundant punctation.—France on stubble and roots of certain Gramineae, principally *Millium*, *Agropyrum*. ----- *purpurea* Sign.
    - cc. Body not bearing large number of setae; adult female oval, plump, cream-colored, with slight tinge of brown on margin; spiracles on lateral margin with crescentic group of closely placed rather large cerores; anal orifice situated in slight de-

pression; anal area with many slender setae, much smaller than anal ring setae.—Kansas on *Bouteloua*.—*nortoni*. Parr & Ckll.

**Sphaerococcus Mask.**—Maskell erected his group *Idiococcidae* for the inclusion of this genus and the genus *Cylindrococcus*. The anal ring has been poorly studied in most of the species of *Sphaerococcus* and in the descriptions of several is not even mentioned. Some of them have already been removed and made the types of other genera. The type species of the genus *Sphaerococcus*, *casuarinae* Mask., has according to the describer an anal ring with anal ring setae in the second nymphal stage and probably also in the first nymphal stage although the anal ring is not mentioned in the description of this stage. Ferris, who has studied this species, reports the presence of an anal ring with six anal ring setae in the adult female and first nymphal stage. In the adult female the anal ring is located at the cephalic end of an invaginated anal tube. The cephalabiae and caudalabiae are present in the first nymphal stage. The presence of an anal ring with anal ring setae would debar this genus from the *Idiococcidae*, the *Cylindrococcinae* of the present work. A single species, *Sphaerococcus sylvestris* Ckll. & King from Massachusetts on white oak, has been recorded from America. The species of *Sphaerococcus* fall into two groups, those forming true galls, apparently always bud galls, or blisters on their host-plants and those not forming abnormal growths but in which the body of the adult female is covered with white cottony or woolly wax or are enclosed in a hard test of wax. The nineteen species listed in Fernald's Catalogue represent several generic types. Ferris has made *distictum* Knw. the type of *Paludicoccus*, *pirogallis* Mask. the type of *Eremicoccus*, and *pulchellus* Mask. the type of *Callococcus*. He has referred *obscuratus* Mask. to *Kuwanina* and *leptospermi* Mask. to *Amorphococcus* and states "that *Sphaerococcus sylvestris* Ckll. & King is probably nothing more than an immature stage of some species of *Kermes*."

**Paludicoccus Ferris.**—A single species, *Sphaerococcus distictum* Knw. from California on *Distichlis*, is the type and sole species of the genus.

**Nidularia Targ.**—An European genus containing a single species, *pulvinata* Planch. The cephalic end of the cyst bears two transverse rows of small conical protuberances. The body of the adult female rests upon an ovisac similar to that of *Pulvinaria*.

**Kuwanina Ckll.**—The type of this genus, *Sphaerococcus parvus* Mask. from Japan on cherry, was the sole species until the reference of *obscuratus* Maskell to this genus.

**Cryptococcus Dougl.**—This genus contains a single species, *fagi* Baer. from Great Britain, France, Belgium, Germany, Bohemia, and Switzerland on birch.

**Kermicus Newst.**—An Indian monotypical genus including wroughtoni Newst. from the nests of an ant, *Oecophylla*.

**Chaetococcus Mask.**—A single species, *bambusae* Mask. occurs in the Hawaiian Islands, Mauritius, Ceylon, and Brazil on *Bambusa*.

## CHAPTER XIV

### SUBFAMILY TACHARDIINAE

#### *The Lac Insects*

The body of the adult female is typically conical or subconical or subglobose with the mouth-parts located at the pointed end of the cone and the anus at the other. Body always irregular in form, bag-like. It is impossible to identify the lateral margins and the aspects are not well defined. The caudal end is never inflated with the cephalic and lateral margins keeled. The antennae are minute, vestigial, consist of three or four segments, and are articulated to the ventral aspect of the head. The eyes are wanting. The mouth-parts, rostrum and rostralis, are always present, the rostrum consists of two segments. The legs are wanting. The metathoracic spiracles are normal in size and ventral in position. The mesothoracic spiracles are large and distinct, always larger than the metathoracic spiracles, and are located near prominent stigmatic processes which are always located near the anus, the distance from the anus varying with the species. The abdominal spiracles are always wanting. The stigmatic clefts and spinae are wanting. The lateral surface of each stigmatic process bears a canella and spiracerores. The anus is located at the end of a prominent anal process. There is usually an anal spine associated with the stigmatic and anal processes. The anus is surrounded by a prominent anal ring bearing about ten anal ring setae. The body through the migration of the mesothoracic spiracles is greatly distorted, so that the abdomen appears to be two or more times as long as the head and thorax together. The abdomen is bag-like or jug-like with three necks. The lateral margins are wanting. All of the segments are fully exposed, none of the coriae between them can be identified, and none of the segments are retracted to form a marsupium. The abdomen is never provided with an anal cleft and opercula or anal lobes and anal setae. The anal ring is always distinct, located on the anal process, and provided with ten anal ring setae located on six plates. The caudal abdominal segment can not be identified. The body, except the stigmatic and anal processes, is not provided with cerores and none of these are octacerores or placerores. The body is never provided with ceratubae. The body is always enclosed in a resinous cell with three adjacent openings, small threads of wax often protruding from the three openings. The rectum is never provided with a long glassy tube of wax or with a chitinized rectal tube bearing rings of anacerores. The body is never naked and gall-like in form. It is never covered or associated with mealy or powdery or cottony wax.

The female nymphs of all stages are provided with a rostrum and rostralis. The three pairs of legs are present in the first nymphal stage

and wanting in all others, and when present are similar in form. The profemora are never greatly enlarged and the prothoracic legs are never fitted for digging. The body is never provided with an anal cleft and opercula, anal lobes and anal setae, octacerores, pilacerores, or ceratubae. The anal ring is distinct, located on an anal process in the second nymphal stage and bears six to ten anal ring setae. The caudal end of the rectum is not chitinized, forming a rectal tube provided with one or more rings of anacerores excreting a long glassy tube of wax. The caudal abdominal segment is not short, narrow, and projecting.

The male has four ocellanae, two dorsal and two ventral. The abdomen is not provided with long lateral filaments and bears two long slender caudal threads of wax. The wings are present and fully formed or wanting. The stylus is distinct, about one-half the length of the abdomen.

This subfamily includes the lac insects of commerce all of which originally belonged to the genus *Tachardia* and previously to the genus *Carteria*. There are probably few of the people who are constantly using shellac who are aware as to how and where it is obtained and that it is an excretion of a minute insect. The wax or lac as it is usually called, from which is derived the shellac of commerce, is excreted by the lac insect, *Tachardia lacca*. Its chief home is the forests of India, Burma, and Assam. While the best quality of lac comes from Burmah and Assam, lac is also produced in Ceylon, Siam, China, and some of the islands of the East Indies. There are about twenty-five thousand tons collected annually in the central provinces of India. This lac has a valuation of about a million and a quarter dollars. All of the lac of commerce is produced on the forest trees in a wild state and no effort is made to produce it artificially or to cultivate it as is done in the case of the cochineal insect. The lac insect lives upon a large number of species of trees, at least sixty according to Froggatt, the most of which belong to the genus *Ficus*, fig.

The following account as to the preparation and use of lac is taken from Froggatt. "The different kinds of lac are known in commerce under many names. Stick lac is the natural production encrusting the twigs just as it is obtained from the forest; seed lac is the stick lac after it has been ground up in water to extract the coloring matter out of the insect, known as lac dye; button and shell lac are prepared from the seed lac by melting the latter. Other forms, such as garnet and liver lac, are produced from different qualities of shellac, the color often differing considerably in the various districts, while some of the fine bright orange

shellac is said to be artificially colored with orpiment. Lac is extensively used for making the finer kinds of sealing wax, and is the chief ingredient in most of the wood polishes, besides the regular lacquer varnish used to coat the boxes, cabinets, and toys known as lacquer ware used so much in China and India. The lacquer ware from Japan, however, is polished with a varnish made from the sap of one of the sumac trees (*Rhus venix*) and not from the insect lac." The coloring matter secured from the bodies of the lac insect is very similar to that obtained from the cochineal insect. Species of the genus *Tachardia* are found in most parts of the world. The following description is based upon the admirable account by Green of the development of two species of *Tachardia*, *fici* and *albizziae*. While it is quite likely that other species will differ somewhat in minor details from this account, yet the discrepancy is not likely to be great.

The nymphs of the first stage have a subdepressed body, are elongate oval in outline with well developed legs and antennae and an anal ring with six anal ring setae. They resemble somewhat in general outline a young mealy-bug, but differ from these insects in that their body is naked, not covered with mealy wax, and are bright red or yellow in color. The antennae consist of six segments, of which the third is greatly elongated and enlarged on the distal half, also the distal segment or sixth, as well as the fifth, bears two very long slender setae. The rostrum is large and conspicuous. The legs are distinct and normal in form. The anal ring is large and each of the six anal ring setae is attached to a small circular plate. The thoracic spiracles are small and inconspicuous. There is apparently a distinct canella with spiracerores associated with each mesothoracic spiracle, but no such structures are connected with the metathoracic spiracles.

The young nymphs soon begin to excrete wax. If one that is two or three days old, is examined, it will be found that the entire body is completely encased in a thin homogenous sheet of wax. Green states that this wax first appears in the form of plates which with increase in size coalesce. The form and general distribution of the wax and the absence of cerores on the surface of the body has led to the suggestion that the wax is the product of all the hypodermal cells excreting together and not of certain cells connected with cerores as in most coccids. A histological study of these cells has not been made so far as I am aware.

The female nymphs at the first molt reduce their legs and antennae to mere vestiges. The body is more swollen and there is a prominent furrow on each side in line with the rostrum, which gives the body a lobed appearance. There is a canella extends obliquely from the former ventral position of each mesothoracic spiracle onto the dorsal aspect, where the mesothoracic spiracles are now located, due to the rearrangement of the folds of the body. Each of these canellae bears numerous cereres or spiracerores. The metathoracic spiracles are normal in position on the ventral aspect and no canellae or spiracerores are associated with them. The anal ring bears ten anal ring setae, each arising from a cuticular plate with a tendency for eight of the plates to fuse into pairs. The portion of the body bearing the anal ring is prolonged and forms the beginning of the anal process.

The test or scale of the second stage female nymph is characteristic in form. As viewed from above, it consists of lobes, three on each side. There is at one end a prominent opening on the meson of the dorsal aspect, this is the caudal opening and the one in which the anal process fits. There is also a prominent opening on each side of the dorsal aspect near the furrow marking the caudal limit of the cephalic lobes. A stigmatic process fits into each of these openings.

The adult females are easily recognized in most species, because they bear a prominent anal spine. This is a pointed prolongation of the cuticle which is located cephalad of the anus on the dorsal aspect. The spine is sometimes placed on a fleshy tubercle, a further prolongation of the cuticle of the body. The function of the anal spine or dorsal spine as it is sometimes called, is unknown.

There are three stages of development through which the early adult female passes, the early adult female or before gestation, the adult female during gestation, and the old adult female or after gestation or after the eggs are laid.

The early adult female is small and similar in general form to the female of the second stage. It differs in that the lobes are more pronounced and the body is wider. The stigmatic processes, the projections which bear the mesothoracic spiracles, are only slightly elevated above the general surface of the body but the canellae and spiracerores are distinct. The spiracles retain their dorsal position and open dorso-laterad. The anal process is large and prominent, the end is truncated, and the truncated portion



bears the anal ring and the ten anal ring setae located on six cuticular plates. These plates bear numerous large cerores. The cuticular periphery of the anal ring is bounded by projecting spine-like processes.

The body of the adult female during gestation is larger and more swollen from the numerous eggs which it contains. It becomes so distorted that the position of the parts are considerably altered. The metathoracic spiracles are small and retain their normal position on the ventral aspect near the rostrum. The mesothoracic spiracles are large and conspicuous and are located at one side of the proximal end of the stigmatic processes. These processes with the distortion and remoulding of the body are elongated and brought nearer to the anal spine and the anal process. There is a furrow, a canella, extends from the spiracle along one side of the stigmatic process to its distal truncate end. Each canella bears numerous spiracerores and its distal end which is continuous on one side with the canella bears several large cerores with small cerores or spiracerores mixed among them. The stigmatic processes were originally known as the lac tubes from the mistaken notion that all the wax of the test was excreted by them. The anal process also becomes more prominent with the swelling of the body. The stigmatic processes with the mesothoracic spiracles, the anal spine, and the anal process are now all near together at one end of the body. The migration in position of the spiracles is probably due to the stretching of the cuticle of the body. The body of the adult female during gestation completely fills the cell in the wax. As the eggs are extruded, the body gradually shrinks and the empty space in the cell about the body of the female is packed with eggs. The young nymphs, when they hatch, emerge through the openings in the cell in which the anus and mesothoracic spiracles fit. The lobed appearance of the body is lost after the female deposits her eggs, and, when it is expanded, is bag-like in form.

The waxy test formed by the female varies in size and form with the species. In some the females are isolated, each female forming a test; in others only a few females, three or four, are found in the same globule of wax and contribute toward its formation; or a considerable number of females, twenty to thirty or a large number, several hundred, form a large thick mass completely encrusting a limb as in the stick-lac of India. The shape of the cell varies also somewhat with the species. The cell of the adult

female is always provided with three openings, one the anal aperture, is slightly larger than the other two, the stigmatic apertures. The apertures are arranged in the form of a triangle, the anal aperture located at the apex of the triangle. The stigmatic and anal processes fit into their respective apertures. The position of the anal spine between these processes would suggest that its function may be to hold the processes in place in the apertures. The wax lining each aperture is different in appearance and consistency and is undoubtedly excreted by the cereres of the stigmatic and anal processes. The spiracerores excrete a fine pulverulent wax or tufts of filaments of wax which extrude from the stigmatic apertures sometimes almost closing them. Green has suggested that this wax may function to prevent the entrance of moisture.

The test of the male is oblong oval in outline, slightly constricted near the oval caudal aperture and the dorsum is supplied with a distinct median carina. The aperture is closed during the quiescent stages with wax. The wax or lac of the male is similar in appearance to the lac formed by the female. The male tests are always formed by single individuals.

The nymphal stages of the male have not been described. The adult male is ordinary in form, some individuals are winged while others even in the same species may be wingless. The caudal end of the abdomen bears a pair of long opaque filaments, which are probably formed of wax. The head is provided with four ocellanac, two dorsal and two ventral. The antennae of the winged forms are provided with ten segments and of the wingless forms with nine. "The genital sheath is elongate, slender, and sharply pointed, rather more than half as long as the abdomen."

This subfamily contains three genera, two of which were originally described as subgenera, which can be separated by means of the following table:—

#### GENERA OF TACHARDIINAE

- a. Insects enclosed in masses of wax surrounding twigs, never in individual tests; body of female elongate and vasiform; abdomen with anal spine. ----- *Tachardia* Sign.
- aa. Insects enclosed in small masses of wax, not completely surrounding twigs, individuals may form separate test; body of adult female more or less globular.
- b. Abdomen of the adult female with anal spine; wax reddish or of resin color. ----- *Tachardiella* Ckil.

bb. Abdomen of adult female without anal spine; wax whitish, not reddish. ----- *Tachardina* Ckll.

**Tachardia** Sign.—This generic name has been restricted to those species forming a large mass of wax. The lac insect of India, *Tachardia lacca*, is the type of the genus. It is found on fig, banyan, *Rhamnus*, *Mimosa*, *Anona*, etc.

**Tachardiella** Ckll.—This genus contains the greater number of the species, over thirty from all parts of the world. The following species have been described from America:—*caerulea* Hemp. from Brazil; *cornuta* Ckll. from New Mexico and Mexico on *Parthenium*; *cydoniae* Hemp. from Brazil on *Cydonia*; *cordallae* Leon. from Argentina on *Cordalia*; *argentina* Dominguez from Argentina on *Acacia*; *fulgens* Ckll. from Arizona and Mexico on *Mimosa*, *Prosopis*, *Coursetia*; *fulvoradiata* Ckll. from Mexico on "Palo de gusano"; *gemmifera* Ckll. from Jamaica on *Chrysobalanus*; *glomerella* Ckll. from New Mexico on *Gutierrezia*; *ingae* Hemp. from Brazil on *Inga*; *larreae* Comst. from southwestern United States and Mexico on *Larrea*; *lycii* Leon. from Argentina on *Lycium*; *mexicana* Comst. from Mexico on *Mimosa*; *nigra* Towns. & Ckll. from Mexico on *Acacia*; *parva* Hemp. from Brazil on *Myrtaceae*; *pustulata* Ckll. from Arizona; *rosae* Hemp. from Brazil on *Rosa*; *rotundata* Towns. & Ckll. from Mexico on "*Ziena*, *Guasima*"; and *rubra* Hemp. from Brazil on *Cydonia* and *Croton*. The *Gascardia madagascariensis* Targ. is a species of *Ceroplastes* and the *Colobopyga magnani* Brethes was evidently referred to this subfamily through an oversight.

**Tachardina** Ckll.—This genus contains a single species, *albida* Ckll., which lacks an anal spine and has white lac. It was described from Natal on *Mimosa*.

## CHAPTER XV

### SUBFAMILY LECANIINAE

#### *The Tortoise Scales*

The body of the adult female is variable in form, usually distinctly longer than broad, sometimes almost circular, frequently convex on the dorsum and concave on the venter, helmet-like in shape and outline. The lateral margins are frequently thin and distinct, if so, usually fringed with marginal setae, margin sometimes wanting or obscure. The segmentation is usually obscure and the coriae are frequently wanting. The caudal end of the body is not inflated and the cephalic and lateral margins are not provided with a keel. The antennae, when present, are normal in form, usually small, and consist of seven or eight segments. The number of segments and their size may be greatly reduced, sometimes wanting. They are articulated to the ventral aspect of the head, usually distant from each lateral margin. The eyes are present. There is a single ocellana located on each lateral margin near the articulation of an antennae. The mouth-parts, rostrum and rostralis, are always present, the rostrum consists of a single segment. The legs are usually present, they are sometimes rudimentary or wanting, when present, they are subequal in length and normal in form. The prothorax are never enlarged, and the prothoracic legs are never fitted for digging. The trochantro-femoral and tibio-tarsal sutures of all normally formed legs are always distinct. The spiracles of the mesothorax and metathorax are normal in form and size and ventral in position. The mesothoracic spiracles are never located near the anus. The abdominal spiracles are always wanting. The ventral aspect of the thorax is provided with spinae and canellae and usually with stigmatic clefts. The abdomen is about as long as the head and the thorax together. It is frequently convex on the dorsal and concave on the ventral aspect, sometimes convex on both aspects. The lateral margins are generally sharply defined, sometimes obscure or wanting. The caudal end is broadly rounded or the caudal portion is produced and, whether rounded or produced, is provided with a distinct mesal cleft. All of the segments are exposed or at least no part of the abdomen is retracted to form a marsupium. The abdomen is always provided with an anal cleft, sometimes apparently wanting, due to the fusion of the margins of the cleft. The opercula are rarely if ever wanting. The anal ring is always present, usually retracted into the anal tube, and provided with six, eight, ten, or more anal ring setae. The anal lobes and anal setae are wanting. The caudal abdominal segment can not be identified. The body is provided with ceriores, but the number is frequently not large and is often limited to the canellae and about the vulva. The body is never

provided with pilacerores, octacerores are rarely present. Ceratubae are frequently present. The body is never enclosed in a resinous cell with three adjacent openings or covered by a scale with or without exuviae, is often naked or nearly so, sometimes enclosed in a compact ovisac and sometimes excreting a mass of doughy wax from the ventral cerores in which the eggs are laid. The rectum is never provided with a long glassy tube of wax or with a chitinized rectal tube bearing rings of anacerores. The body is frequently naked and sometimes gall-like in form, but if so, always provided with normal antennae and legs and anal ring and anal ring setae.

The nymphs of all stages are provided with a rostrum and rostralis. The three pairs of legs are present in the first nymphal stage and usually in all the others, particularly if they are present in the adult, and are similar in form. The profemora are never greatly enlarged and the prothoracic legs are never fitted for digging. The body is provided with an anal cleft, rarely wanting, and with opercula in different stages of migration from margin of body to cephalic end of anal cleft in nymphs of different ages. The anal ring is always distinct and bears six to ten or more anal ring setae. The anal lobes and anal setae, as such, are present only in the first nymphal stage. Octacerores are rarely present, pilacerores or ceratubae are never present. The caudal end of the rectum may be strongly chitinized, but is never modified into a rectal tube provided with one or more rings of anacerores excreting a long glassy tube of wax. The caudal abdominal segment is never protuberant.

The male has ocellanae, the number varying with the genus. The abdomen is not provided with long lateral filaments or tufts of long wax filaments, but may bear two long thread-like caudal filaments of wax. The stylus is short and conical.

The members of this subfamily are, as a rule, when denuded of their wax, homogenous in appearance, not only as adults but as nymphs. The most striking features in the adult female are the mesal slit or cleft at the caudal end of the body which, except in a few genera where the two sides of the slit have fused with an obliteration of the line of fusion, is rarely absent. There is a corresponding slit in the young nymphs, bounded on each side by a distinct lobe or plate, an operculum, which bears a single large anal seta and frequently one or more other smaller setae.

There is considerable variation among the numerous genera as to the amount of wax excreted, which gives the body of the adult female a very different look according as to whether the amount of wax is large or small. The amount of wax formed by the nymph except in certain genera is as a rule not large, so that the body of the great majority of the species is generally stated to be naked. The genera *Lecanium*, *Saissetia*, *Physokermes* and their allies are such genera and are said to have the body naked. This is not

absolutely true for the dorsal and more often the ventral aspect is covered more or less with mealy wax. These species are, however, truly naked when compared with representatives of such genera as *Ceroplastes* which is completely encased in a mass of wax or *Pulvinaria* which excretes a large white doughy mass of wax several times as long as the body or as *Takahashia* where the wax excreted is a tail several inches long. In *Platinglisia* the waxy covering is glassy, in *Signoretia* woolly, and in *Eriopeltis* a closely felted sac.

The body of the adult female in those genera where the body is said to be naked, as *Lecanium*, is fairly uniform in appearance. This form of body has been taken as the type for the following description. The general outline is that of an elongate oval figure, passing through the various stages to that of a rotund figure or one that is almost or wholly globular. The two surfaces of the body are near together, the dorsal convex and the ventral concave. This gives the characteristic scoop-like figure of the shell of a tortoise or of a steel war helmet and hence the vernacular name of the group. Those species that are encased in a mass of wax, varying in amount and thickness with the species and those species that form large ovisacs depart more or less from this general form. Those that form ovisacs have the body flat and both surfaces more or less convex and approximate the condition of a typical eriococcid and so far as form is concerned represent the generalized end of the series of genera. The person with an eye for judging form will note, however, that even in these genera, there is a striking resemblance between the wax excreting and the naked species. A prominent feature of most of the naked species is the strongly concave ventral aspect of the body of the older nymphal stages and of the adult female.

A noticeable feature of the body is the entire absence of any indication of segmentation in the adult female. The only means of identifying the extent of the three primary regions is through the presence and articulation of the antennae, rostrum, legs, and the position of the thoracic spiracles.

The typical form of the body, shaped like a tortoise-shell, makes the margin of the body sharp and prominent, forming a distinct margin. This margin is generally fringed with setae which vary considerable in number, size, and shape. They are known as the marginal setae. While in many species these setae

are typical in form with a slender pointed flexible shaft, in others the shaft is stiff and inflexible or spine-like. The distal portion of the shaft is frequently distinctly enlarged or dilated forming a clavate seta. Such setae may have the clavate distal portion of the shaft indented or toothed forming frayed or furcate setae. The marginal setae in certain genera have been modified into flattened scales which are broad oval in outline or almost round, broader than long. They differ from the lepidopterous scales in their uniformly convex untoothed margin. They are designated as flabellae by Green and as flabelliform marginal hairs by others.

There is on the dorsal aspect of certain species a varying number of small tubercles, ten to twenty, which have been described and figured by both Thro and Green. They were named submarginal tubercles by the latter, who considered them as glandular in nature. There are usually about five on each side of the body near the lateral margin. Thro describes in one species a mesal row of twenty. These minute structures rest upon the surface of the cuticle and resemble in profile a small neckless flask with a central dipper. Since they are likely to occur upon any part of the dorsum, they have been named the dorsal tubercles.

The caudal extent of the head can not be determined. The eyes are usually inconspicuous or wanting, when present they are small, slightly convex areas which are sometimes darkened with pigment and located on each lateral part of the ventral aspect of the head.

The antennae usually consist of six to eight segments. This number may be greatly reduced or the antennae modified into mere tubercles, while in certain genera the antennae are always wanting. In some genera the length of the segments is greatly reduced and the antennae as a whole greatly shortened, while the typical number of segments may be present. The comparative length of the segments of the antennae, expressed in the form of a formula, has been used by certain workers in differentiating species. Such characters are no more reliable here than in the other subfamilies. This fact and the general uniformity of the number and arrangement of the antennal setae has been noted by Thro, who found the number identical in the different species that he studied and in cases noted where there was a difference and he was able to find material for study, found that some of the setae had been broken off and overlooked. The interantennal setae are

frequently present, but instead of being arranged to form the corners of a four sided figure are frequently placed in a transverse or approximately transverse line.

The mouth-parts are normal in form and position. The rostrum consists of a single segment. Its distal margin is rounded. There is a prominent crumena connecting with the cavity extending through the rostrum in which the loop of the rostralis is held. The tendons attached to the proximal end of the mandibles and the maxillae are prominent and the tendons attached to the infunda, the hypopharynx of Berlese and Green, are very large. The ventral aspect of the endoskeleton of the head, the so called cradle of Green, is bounded on the ventral side by a broad band, the clypeus of Green. This latter structure, however, is always located within the lumen of the head and since the clypeus is a sclerite of the external skeleton, can not be considered as homologous with the clypeus. This band has been called the clavus and the so called cradle is derived from the tentorium, consisting in the main of the arms of the metatentoria.

The legs, when present, are completely developed and all parts are present, although they are frequently so small that their tips project only slightly or not at all beyond the lateral margin of the body. The tip of the tarsus frequently bears a pair of long slender dorsal digitules and the claws a pair of short and stouter ungual digitules.

The spiracles open on the ventral aspect, each mesothoracic spiracle just laterad of the articulation of a prothoracic leg and each metathoracic spiracle about in line with a mesothoracic spiracle and midway between the mesothoracic and metathoracic legs. The spiracles of this subfamily are frequently figured as distinct trumpet-shaped or hourglass-shaped structures. All of which except the opening, the spiracle, is a cavaera.

There is extending from each spiracle to the lateral margin of the body in most species a more or less distinct furrow. Each of these furrows is a canella, which bears a varying number of cerores, the spiracerores. They are also known as the grouped orifices of the thoracic spiracles, glandular pores or spinnerets, spinnerets of the spiracles, glands of the spiracles, parastigmatic glands, and parastigmatic pores. They were first named in the *Diaspidinae* where the canellae and spinae are always wanting. These cerores excrete a powdery wax which serves to keep the canellae open and permit the ingress of air to the spiracles. There



is frequently at the margin of the body a more or less distinct indentation where the canellae terminate. These indentations are the stigmatic clefts, also known as spiracular depressions or spiracular grooves. The wax excreted by the spiracerores frequently projects as a white powdery mass from the stigmatic clefts. The lateral ends of the canellae are usually provided with large spine-like setae which are located in the stigmatic clefts and serve to keep the mouth of the canellae open. These setae, the spinae, also known as stigmatic or spiracular spines or setae, vary greatly in form and size from the marginal setae and are useful as characters in identifying the species of this subfamily. The number of spinae varies in the different species. There may be one, two, three, four, five, or six in each stigmatic cleft. The great majority of the species are provided with three spinae in each cleft. The median one in such species is known as the median spina and the others as lateral spinae. The median spina is usually much longer than the lateral or all the others where there is more than three. In some species the spinae are very short and broad, broader than long, while in others they may be small pointed normal setae.

The abdomen is usually convex-concave like the thorax. There is no indication of segmentation in the adult female. The marginal setae and marginal scales, when these latter are present, extend around the margin of the abdomen.

The most striking feature in the structure of the abdomen is the deep mesal cleft or emargination, the anal cleft. The sides of the cleft frequently overlap so that the cleft appears simply as a longitudinal suture. In a few genera referred to this subfamily, as *Aclerda*, the anal cleft is wanting. It is assumed that in such cases the sides of the cleft have fused with a complete obsolescence of the line of fusion. The length of the anal cleft varies somewhat with the genus or species, it is generally about one-fourth to one-fifth the length of the body, but in some cases, as *Protopulvinaria*, it may be one-half or more of the total length of the body. In those species deeply imbedded in wax as certain species of *Ceroplastes*, the caudal portion of the body has been prolonged into a prominent strongly chitinized horn or handle-like structure and the anal cleft is located at the caudal end of the horn. This horn is known as an opercularia. The length of the opercularia varies not only with the species but with the depth of the wax excreted. In those species where the amount of wax is considerable, the opercularia is almost one-half the length of the body. It varies

also in position, in some species it is directed caudad and in others dorsad.

A structural feature equally as striking as the anal cleft is the presence in the adult female of a triangular plate on each side of the cephalic end of the anal cleft. These plates are adjacent, exposed on the dorsum, and each plate is known as an operculum. They are also known as the anal plates, valve anali, while Green considered the two plates as a single structure and designated the two together as the operculum or anal operculum and each of its parts as an anal plate or valve of the operculum. The shape of the opercula varies with the species. The angle at the caudal end of each operculum is known as the apex, the one at the cephalic end as the inner angle, and the one on the lateral margin as the outer angle. The margin connecting the inner angle and the apex is known as the mesal or inner margin, the one connecting the apex and the outer angle as the caudo-lateral or outer margin, and the one connecting the inner and outer angles as the cephalo-lateral margin or base. Each operculum is attached to the body along the lateral margin. The outer angle is wanting in semicircular opercula and the base and outer margin form a continuous curve.

The cuticle ventrad of the opercula in this subfamily is invaginated and forms a barrel-shaped tubular structure or eversible-sac continuous with the rectum. This is the "organo retrattile anali" of Berlese and the anal tube of Thro and other writers. As to just how this tube originated is not clear. A similar result would be obtained if the anus and anal ring were to migrate away from the exterior of the body, pushing the rectum into the body cavity and pulling the portion of the cuticle surrounding the anal ring into the depression formed to bound the tube extending from the anal ring to the exterior. The anus is located inside the body. It is surrounded by a distinct anal ring which bears a varying number of anal ring setae, six, eight, ten, or more, which project through the anal tube and when longer than the anal tube may be observed projecting from its caudal end. The anal ring usually bears prominent orbacerores. There are two projections on the ental surface of the anal tube adjacent to the anal ring to which large muscles are attached. These muscles extend and retract the anal tube. They function also for extruding the excrement or honeydew and for everting the anal ring. The surface of the cuticle lining the lumen of the anal tube is finely longitudinally striated. These striations are frequently

mistaken for setae and described as such. The anal tube is normally retracted and must be everted in order to expose the anal ring and the anal ring cerores or orbacerores. These cerores in some species excrete a fine tube of wax which extends beyond the body and serves to carry the honeydew still farther away from it. The anal ring in some species is subdivided into two parts or nearly so and frequently one-half is larger than the other. Berlese in his "Le Cocciniglie Italiane vivente Sugli Agrumi" gives several excellent figures of the anal tube and its associated parts. This masterpiece of Berlese, so rarely noted in the literature of the Coccidae that one might readily forget its existence, is the most complete and comprehensive work that has ever been published dealing with the morphology of coccids.

The caudal end of the anal tube on the ventral aspect may bear two, four, six, or eight setae in a transverse or nearly transverse row. The setae were named by Thro the fringe setae. The seta at each lateral end of this row when there is more than two fringe setae present, is usually larger than the mesal setae. When there are only two fringe setae, each is located near a lateral margin of the anal tube; when there is four, they are usually equidistant from each other, two on each side of the meson or adjacent near each lateral margin. While the fringe setae are always arranged in a transverse row, it is not always a straight line but usually more or less curved.

The ventral aspect of the outer wall of the anal tube in certain species bears two longitudinal rows of setae, the hypopygial setae. These rows usually converge cephalad or are parallel and appear to be a continuation of the fringe setae.

The position of the anus and anal ring at the cephalic end of the anal tube and forming the cephalic boundary of its lumen has already been indicated. The position of the vulva is difficult to identify. It is located on the ventral aspect cephalad of the external opening of the anal tube and the fringe setae.

The lateral portion of the ventral aspect of each operculum frequently contains a distinct longitudinal thickening, a ventral thickening. It is also known as the ventral chitinous process of the ventral plate. The ventral thickenings vary considerable in length and breadth. The row of fringe setae appears to be limited on each side by a ventral thickening.

The distal half of each operculum bears several small setae. There is one group which appears to form a line continuous with the

caudal end of the ventral thickening. These setae are the subapical setae. While there is frequently two subapical setae, there may be as many as five or more. The small setae, generally if not always four in number, located caudad of the subapical setae are the apical setae. They may be located on the dorsal aspect or on the ventral aspect or a part of them may be located on the dorsal and the remainder on the ventral aspect. At times some may be located on the margin of the operculum. The caudal half of the dorsal surface in certain species bears a single large seta, the discal seta. This seta is of about the same size as the subapical setae and is located on the same portion of the dorsal aspect of the operculum, so that in mounted transparent specimens, they appear to be closely associated.

The ventral aspect of the body cephalad of the opercula bears a series of three or more pairs of small setae, the abdominal setae of Green. These setae are usually arranged in two longitudinal rows. The ventral aspect of the abdomen cephalad and laterad of the opercula also bears a few scattered ceriores, the circumgenital glands of Green.

The cuticle of the dorsal aspect of certain lecaniids, as the species of the typical genus and its allies, when studied under transmitted light, show a more or less distinct pattern of variously shaped areas. These areas are usually round or oval or suboval and appear as large cellular areas. They frequently consist of a series of concentric lighter and darker colored bands or areas and are known as the cells or as the dermal cells or pores or cellulae. They are not cells in a histological sense but are probably thickenings of the cuticle of different density. They vary greatly in number, shape, and size in the different species. The cellulae are more distinct in old individuals, they also become indistinct after a long boiling in caustic potash. Those species, where the cellulae form a series of disconnected rings or ovals, are said to have the cuticle alveolate. When these areas are connected forming a series of adjacent polygonal areas, these areas are designated as tesserae.

The opening in each cellula is, so far as observed, always the mouth of a ceratuba or an oraceratuba. The oraceratubae are usually, if not always, eccentric in position. The ceratubae appear to be characteristic in form but vary greatly in length. Each generally consists of a proximal straight tube bearing a smaller curved portion or tube. The change in diameter of the two tubes

is due to a sudden constriction which is limited to one side. The distal end of the small tube bears a bouquet-like swelling.

The adult females of the Lecaniinae usually produce eggs, which are in most cases deposited under the concave ventral aspect of the body or in an ovisac. Many species instead of depositing their eggs give birth to living young. In such cases the ruptured egg-shell and the young nymph may be extruded from the vulva at the same time. Such species differ from the true oviparous species only in that the eggs are retained in the body of the female, in the oviduct, until they hatch. Certain writers have made the mistake of considering all species whose females give birth to living young as reproducing parthenogenetically. While undoubtedly many females are able to produce young without being fertilized, it is quite likely a much larger number give birth to living young from eggs that have been fertilized but are retained by the female until after the eggs hatch. It is not impossible that many species reproduce in both ways, that is, that certain females at certain seasons reproduce parthenogenetically while other individuals reproduce in the normal way. It is difficult to explain why there should be an absence of males at certain times. The giving birth to living young is not a proof of parthenogenesis.

The eggs are ovoid in shape and white, yellow, or red in color. They are of common occurrence in those species which are naked and where the ventral aspect is concave. In such cases the body of the female serves as a plate for covering and protecting the eggs. The edge of the body adheres to the host-plant and, when the body is raised, the space under it is seen to be packed with eggs. The cerores located on the ventral aspect of the body excrete a powdery wax, the amount varying with the species, which is mixed with the eggs.

The females in certain genera, as *Pulvinaria*, are naked until they become adult and are ready to deposit their eggs. They then begin to excrete a mass of doughy wax from the numerous cerores located on the ventral aspect of the body. This wax is gradually piled up as a pad or cushion until the caudal end of the body is gradually raised from the host-plant and the body assumes a vertical position. The insect is attached to the host-plant only by the mouth-parts and the ovisac, which is often several times the length of the body, and projects behind it. As a result the body of the adult female after all the eggs are laid is often washed off by the rain while the wax containing the eggs may remain for a

long time in contact with the bark of the plant. The adult female in other genera forms a loosely or closely felted cylindrical sac of wax in which the eggs are deposited. In *Ceroplastes* the body is completely encased in wax, formed by the fusion of plates of various sizes and shapes. The ventral aspect of the body contracts away from the wax surrounding the body and forms a cavity in which the eggs are deposited. A similar condition is found in other genera where the body is completely encased in wax. The formation of a definite ovisac is usually limited to the adult female but in *Eriochiton* according to Maskell the covering of wax is formed during the last nymphal stage. In *Ceroplastes*, if the wax of the adult is considered as an ovisac, the formation of the primary plates from which the wax of the adult is derived begins in the first nymphal stage. The number of plates increases in each stage and in many species the shape and symmetry of the plates is lost by their fusion into a thick shapeless mass. But as Green points out, the plates of wax formed by the first and later nymphal stages can often be identified in the mass of wax encasing the adult female. The number of molts undergone by the individuals of this genus and the relation of the exuviae to the wax is not understood.

Where the body is deeply encased in wax, as in the genus *Ceroplastes*, the volume of wax may be greater than the volume of the body. While in this genus the wax and body together frequently form a globular mass, this is not always true, for in some species of *Ceroplastes* and in the species of such genera as *Vinsonia*, *Ctenochiton*, and *Inglesia* the form of the wax is definite and characteristic. The wax is generally designated as a test where the body is encased in a mass that is hard, horny, or glassy. The term test is used, however, by some writers to include the covering of wax no matter what its form. The formation of a test is not peculiar to the Lecaniinae, but it is found in genera of other subfamilies.

The sexes of the lecaniids are not distinguishable in the first nymphal stage. The individuals of this stage are oval in outline, usually somewhat depressed with well developed legs and antennae. The latter are usually provided with six segments. The young nymphs are very active, searching out all parts of the plant and with their ungainly appearing legs and antennae resemble mites or acarids. The caudal end of the body is usually provided with a distinct anal cleft. The most striking feature which seems to be

characteristic of practically all the first stage nymphs of species of this subfamily, is the presence of a distinct operculum on each side of the anal cleft. These instead of being at the cephalic end of the anal cleft are at the caudal end and form a part of the caudal margin. Each operculum bears a single large seta, an anal seta, and often other much smaller setae. The opercula are considered as the homologues of the anal lobes and by some as the homologues of the last abdominal segment, but more strictly should be homologized with the penultimate segment. The thoracic spiracles are always present, but there is some variation in the presence and size of the canellae, stigmatic clefts, spinae, and spiracerones. The anal ring and the anal ring setae are present and situated at the cephalic end of the anal tube which opens at the cephalic end of the anal cleft. The anal ring and anal tube and their associated parts are frequently extruded as a bag-like structure after treatment with caustic potash. The possession of an anal ring and anal ring setae and especially of anal lobes and anal setae in the first nymphal stage shows that there is a phylogenetic relationship existing between the lecaniids and eriococcids.

The female nymphs of the second stage have legs and antennae that are smaller than those of the first stage. They resemble more closely the adult females in general appearance. This is due to the size in the naked species and to the increase in the amount of wax in those genera excreting a covering of wax. The opercula, while they are not yet located at the cephalic end of the anal cleft, have migrated away from the caudal margin and at the first molt lost their anal setae. A second molting of the cuticle transforms them into adult females. It is not difficult to understand how the naked species are able to molt, but in the species of such genera as *Ceroplastes* which bear a test of wax of considerable thickness which adheres closely to the body throughout life, it is not easy to understand how this takes place. It has been suggested by Green, since in this genus the plates of wax excreted by the dorsum and later of the larva can be recognized in the test of the adult, the molted skin must be incorporated in the mass of wax of the adult.

The males are said to molt three times and to pass through three nymphal stages before becoming winged adults. They are difficult to separate from the females during the second nymphal stage until they have formed their cocoons, which in the great majority of the males of this subfamily is a subdepressed, thin,

glassy, test of wax. This test is formed toward the close of the second nymphal stage. It is divided into a series of symmetrically arranged areas by a series of raised or thickened lines. The number of these areas varies from six to nineteen. A common type of the naked lecaniids is to have two elongate mesal or dorsal areas, a cephalic marginal area, and about three lateral marginal areas on each side, or nine areas in all. The males of many genera are unknown. In the genus *Cryptes* the cocoon is felted, while in *Ericerus*, a Chinese species, the males are gregarious and envelope themselves in a mass of wax, which is of such amount that it was collected and used for the making of candles before the introduction of paraffin candles. The third nymphal stage of the male is passed under the cocoon. The developing legs and antennae of the adult are prominent. The second and third exuviae are shed while under the cocoon. They are pushed out, when cast, from beneath the posterior extremity.

The adult males are similar to those described in previous subfamilies so far as their general form is concerned. There is considerable variation among the various species as to the number of ocellanae present. Newstead figures the facets of twelve simple eyes in *Lichtensia*, eight in *Vinsonia*, and six in *Pulvinaria*. The caudal pair of the dorsal aspect are probably ocelli and the others are ocellanae. The caudal end of the body may bear a pair of conspicuous thread-like filaments of wax which are wanting in some genera. The stylus is generally a long straight tube.

#### GENERA OF LECANIINAE

- a. Body of adult female not naked, always forming or attached to or encased in distinct mass of wax of varying form and consistency or body covered by thin film of opaque or glassy wax; abdomen of adult female sometimes with segmentation clearly indicated.
- b. Wax excreted by adult female doughy or cottony, situated beneath or behind or entirely enclosing body, body never covered with thin film of wax; abdomen of adult female sometimes with segmentation clearly indicated.
- c. Body of adult female more or less enclosed, frequently entirely enclosed in cottony or felted ovisac, wax rarely limited in great part to dorsal aspect; abdomen of adult female sometimes with segmentation clearly indicated.
- d. Antennae of adult female consisting of eight segments.
- e. Mesothoracic and metathoracic legs much longer than prothoracic, tarsi of latter secondarily divided into two segments; antennae of first stage nymphs consisting of



six segments; anal ring of adult female with eight and of first nymphal stage of six anal ring setae.....

*Exacretopus* Newst.

- ee. Mesothoracic and metathoracic legs subequal in length with prothoracic legs; tarsi of all legs consisting of single segment.

- f. Body of adult female greatly elongated, much longer than broad.

- g. Body of adult female elongate with parallel sides; legs normal in form, slender and well developed; anal ring with six anal ring setae.....

*Luzulaspis* Ckll.

- gg. Body of adult female twice as long as wide; legs normal; antennae consisting of seven or eight segments; antennae of first nymphal stage consisting of six segments. ....*Spermococcus* Giard.

- ff. Body of adult female oval or suboval in outline, not greatly elongated.

- g. Body of adult female margined with distinctly thickened marginal setae.

- h. Spinae pointed, stout, subequal in length or smaller than marginal setae; body of adult female except a small cephalic portion, completely enclosed in felted white ovisac; anal ring of adult female with eight anal ring setae.....*Lichtensia* Sign.

- hh. Spinae much larger than marginal setae; body of adult female completely enclosed in compact striated ovisac; anal ring of adult female with eight anal ring setae.....*Stotzia* Marchal.

- gg. Body of adult female margined with short, fine pointed setae; body of adult female covered by ovisac of curled threads of wax divided into four trapezoidal areas, which in egg laying female completely covers dorsal aspect; anal ring of first nymphal stage with eight anal ring setae....*Euphillipia* Berl. & Silv.

- dd. Antennae of adult female with less than eight segments.

- e. Antennae of adult female consisting of seven segments.

- f. Body of adult female not enclosed in spherical felted ovisac with elongated dorsal opening.

- g. Body of adult female oval or elliptical, with loosely felted excretion of wax, especially in second nymphal stage, but absent or inconspicuous in adult female; tarsi longer than tibiae; body with marginal fringe.

*Eriochitin* Mask.

- gg. Body of female elliptical and convex, with closely felted ovisac; cuticle with many large circular cerores; anal ring with six anal ring setae; margin with prominent marginal setae....*Malloccoccus* Mask.

- ff. Body of adult female enclosed in spherical felted ovisac with elongated dorsal opening; anal ring of adult female with six anal ring setae and their tibiae longer than their tarsi.....*Austrolichtensia* Ckll.
- ee. Antennae of adult female with less than seven segments.
- f. Antennae of adult female consisting of six segments.
  - g. Wax excreted by adult female not limited for most part to dorsal aspect; stigmatic clefts without spinae.
  - h. Body of adult female elongate, two or more times as long as broad, antennae and legs short and stout; ovisac cottony or felted; dorsum with numerous truncated setae.....*Eriopeltis* Sign.
  - hh. Body of adult female oval or suboval, not twice as long as broad.
    - i. Adult female with body enclosed in felted ovisac; legs and antennae normal in size; insects arboreal in habits; anal ring of first stagenymphs with eight anal ring setae.....*Fillipia* Targ.
    - ii. Adult female with body enveloped in loose white cottony wax or in thin shell of hard wax; legs and antennae complete in form but greatly reduced in size; insects subterranean in habits; antennae of adult female sometimes consisting of eight segments.....*Lecanopsis* Targ.
  - gg. Wax excreted by adult female limited for most part to dorsal aspect, excreted from prominent lateral or mesal rows of cerores with cuticular tubes; stigmatic clefts with four spinae.....*Cronema* Mask.
- ff. Antennae of adult female rudimentary, segmentation indistinct, four segments or less; legs rudimentary, stout conical claw-like protuberances.....*Pseudophillipia* Ckll.
- cc. Body of adult female excreting doughy or cottony ovisac situated beneath or behind body of insect; abdomen of adult female never with segmentation indicated.
- d. Adult female not excreting an ovisac that is elongated posteriorly; dorsum of insect sometimes covered with wax.
- e. Antennae consisting of eight segments; ovisac cone-shaped and fluted; body of insect free from host-plant on end of conical ovisac; anal ring with ten anal ring setae...  
*Pulvinella* Hemp.
- ee. Antennae consisting of seven segments; ovisac not conical with fluted sides; dorsum of second nymphal stage with lamellae of wax.....*Pseudopulvinaria* Atk.
- dd. Adult female excreting ovisac that is elongated posteriorly behind body of the insect and that does not cover body at all.
- e. Body of adult female triangular in outline; ovisac only slightly developed, mere fringe around hind margin of

body; anal ring with six anal ring setae.....

*Protopulvinaria* Ckll.

- ee. Body of adult female oval or suboval in outline; ovisac usually well developed.
- f. Ovisac at most never more than four or five times as long as broad, attached to host-plant throughout its entire length.
  - g. Body of adult female soft, pink in color in front, greenish on dorsum with minute black specks, cephalic part of dorsum with white area of wax, body with irregular patches in three longitudinal rows; antennae consisting of eight segments....*Philephedra* Ckll.
  - gg. Body of adult female hard and strongly chitinated, dorsum usually naked, if provided with wax, not arranged in longitudinal rows.
    - h. Body with dorsum entirely covered with felt-like white secretion of wax in two parts, lateral portion and mesal portion; antennae of adult female with eight segments; anal ring with six anal ring setae. ....*Tectopulvinaria* Hemp.
    - hh. Body with dorsum naked, at most only covered with powdery wax; antennae of adult female normally with eight segments, sometimes with seven; anal ring with eight anal ring setae.....*Pulvinaria* Targ.
- ff. Ovisac greatly elongated, always much longer than broad, attached to host-plant only at one end; antennae of adult female consisting of seven segments; anal ring apparently with six anal ring setae....*Takahashia* Ckll.
- bb. Wax excreted by adult female horny or opaque or glassy, thick or thin mass or sheet of wax closely attached to or free from body of insect, never doughy or cottony mass; abdomen of adult female never with segmentation indicated.
- c. Adult female with legs present and normal in form and size.
  - d. Adult female with antennae present and normal in form.
    - e. Test of adult female consisting of opaque waxy wax, more or less thick, never thin and brittle.
    - f. Test of adult female not with marginal fringe or with radiating processes of wax.
      - g. Abdomen of adult female usually with a more or less distinct opercularia; antennae of adult female consisting of six to eight segments; margin of body of adult female with marginal setae, never with spearhead-shaped spines.....*Ceroplastes* Gray.
      - gg. Abdomen of adult female never with opercularia; antennae of adult female obscurely segmented; margin of body with few marginal setae and numerous spearhead-shaped spines.....*Cardiococcus* Ckll.

- ff. Test of adult female always with a marginal fringe or with radiating processes of hard wax.
  - g. Test of adult female with seven prominent radiating processes of wax, insect star-like in appearance; opercularia present but small; antennae of adult female consisting of six segments.....*Vinsonia* Sign.
  - gg. Test of adult female not with seven radiating processes but with marginal fringe of prominent tooth-like projections of wax; opercularia never present; antennae of adult female consisting of seven segments. .........*Ctenochiton* Mask.
- ee. Test of adult female glassy, thick or thin and brittle, never opaque and thick.
  - f. Test of adult female perfectly flat or only slightly convex; antennae of adult female consisting of eight segments.
    - g. Test with mesal part of dorsal portion subdivided into small oval plates; body of adult female about as broad as long. .........*Lagosinia* Ckll.
    - gg. Test apparently subdivided into four plates, one on the dorsum, one on each side, and one at the caudal end; body of adult female nearly twice as long as broad and anal ring with ten anal ring setae.....*Alichtensia* Ckll.
- ff. Test of adult female not flat, usually irregular in form and strongly convex, approaching spherical.
  - g. Test of adult female conical with its surface fluted; antennae of adult female consisting of five segments; marginal setae numerous, short, sharp, and conical. ....*Educellia* Hemp.
  - gg. Test of adult female not conical and if approaching conical form, not longitudinally fluted.
  - h. Test of adult female with distinct air-cells.
    - i. Insect living free, never forming galls on plants; test of adult female always divided into plates like the shell of tortoise and striated with rows of air-cells, not free from body of insect; antennae of adult female consisting of six segments. .........*Inglisia* Mask.
    - ii. Insects not living free, forming galls upon roots of plants; test of adult female not divided into plates and striated, air-cells running together, forming long air-spaces, not free from body of insect; antennae of adult female consisting of seven or eight segments.....*Cryptinglisia* Ckll.
  - hh. Test of adult female never with distinct air-cells.
    - i. Test of adult female divided by transverse de-

- pression, portion on each side of depression elevated and subconical with grooves radiating from their apices, probably not free from body of insect; antennae of adult female consisting of eight segments. .... *Parafairmairia* Ckll.
- ii. Test of adult female convex, subglobular, free from body of insect, surface roughened by irregular granules or symmetrical polygonal plates of wax; antennae of adult female consisting of eight segments. .... *Ceroplastodes* Ckll.
- dd. Antennae wanting or indicated only by two impressions; insect enclosed in test that is deeply incised at stigmatic and anal clefts; opercula twice as long as wide; insects living in nests of ants. .... *Myroecanium* Beccari.
- cc. Adult female with legs rudimentary or wanting.
- d. Adult female with antennae present, consisting of one to seven segments.
- e. Adult female covered by hard brown test, mesal portion formed during nymphal life; antennae consisting of seven segments; cuticle of dorsal aspect not with large alveolae. .... *Lecanochiton* Mask.
- ee. Adult female covered by thin glassy test, all formed by adult; antennae short with indistinguishable segments; cuticle of dorsal aspect with large alveolae. .... *Neolecanium* Ckll. & Parr.
- dd. Adult female with antennae wanting.
- e. Test of adult female flat and circular, divided into two parts on dorso-meson, with rows of air-cells. .... *Platinglisia* Ckll.
- ee. Test of adult female always more or less convex and never provided with air-cells.
- f. Test of adult female convex, thin glassy scale, divided into two parts by longitudinal furrow, forming sub-lateral low cones with concentric but not longitudinal striae; anal ring with seven anal ring setae. .... *Pseudokermes* Ckll.
- ff. Test of adult female convex, semitransparent thin glassy scale, divided into two parts by longitudinal furrow, with low eminence on each side of furrow, provided with radiating and concentric striae; anal ring with six anal ring setae. .... *Schizochlamidea* Ckll.
- aa. Body of adult female always naked, never attached to or encased in distinct mass of wax of varying form and consistency or with body covered by thin sheet of opaque or glassy wax, at most only with powdery bloom or thin covering or patches of pulverulent wax on dorsal or ventral aspects; abdomen of adult female never with segmentation indicated.

- b. Adult female with legs and antennae always present and antennae segmented.
  - c. Abdomen of adult female conspicuously transversely furrowed, appearing as if distinctly segmented, as seen in unmounted specimens from dorsal aspect; antennae of adult female short and thick, with six segments; legs rudimentary, segments short and swollen. -----*Alccanopsis* Ckll.
  - cc. Abdomen of adult female never with prominent transverse furrows so as to appear as if segmented.
  - d. Adult female with margin of the body fringed with marginal setae, never with scales.
  - e. Body of adult female always alveolate, never with tesserae.
    - f. Abdomen of adult female always with distinct anal cleft with opercula near margin of the body.
      - g. Cuticle of dorsal aspect with minute microscopic pits or alveolae, distance between alveolae always several times diameter of alveolae.
      - h. Adult female with alveolae never symmetrically arranged, bounding tesserae-like areas.
        - i. Body of adult female flat or slightly convex; antennae consisting of seven or eight segments; median spina about twice as long as lateral spinae; opercula usually longer than broad; anal ring with eight anal ring setae.-----  
*Lecanium* Burm.
        - ii. Body of adult female distinctly convex, opercula usually broader than long.
          - j. Adult female with antennae consisting of seven segments; median spina usually less than twice as long as lateral spinae; anal ring with eight anal ring setae.-----  
*Eulecanium* Ckll.
          - jj. Adult female with antennae consisting of seven or six segments; median spina usually three times as long as lateral spinae.-----  
*Mesolecanium* Ckll.
    - hh. Adult female with alveolae symmetrically arranged and bounding tesserae-like areas; antennae consisting of seven or eight segments; anal ring with six anal ring setae.-----*Stictolecanium* Ckll.
  - gg. Cuticle of dorsal aspect with large often nearly adjacent alveolae, the distance between alveolae not several times diameter of alveolae.
    - h. Body of adult female slightly convex or hemispherical, lateral portions never vertical; antennae of adult female consisting of eight segments; anal ring with eight anal ring setae.-----*Saissetia* Depl.

- hh. Body of adult female with lateral portions perpendicular, edge of dorsal portion overlapping at top like roof of house; antennae of second nymphal stage of female with seven segments.-----  
*Platysaissetia* Ckll.
- ff. Abdomen of adult female with anal cleft and opercula located near middle of dorsal aspect.
- g. Body of adult female spherical with opercula located near middle of length of body; antennae minute, consisting of eight segments in adult female and of six in first nymphal stage, anal ring of first nymphal stage with seven anal ring setae; dorsum of adult female and of nymphs not with two cephalic and two caudal groups of ceroses.-----*Cryptes* Mask.
- gg. Body of adult female not spherical, flat and corrugated, with opercula located near middle of length of body; antennae of adult female consisting of nine segments and of first nymphal stage of six; dorsum of female in all stages with two prominent cephalic and two caudal groups of ceroses.-----  
*Hemilecanium* Newst.
- ee. Body of adult female flat and convex, never spherical, never with alveolae, but always with tesserae; antennae of adult female with eight segments; anal ring with six anal ring setae.-----*Eucalymnatus* Ckll.
- dd. Adult female with margin of body fringed with flattened setae or scales; antennae consisting of eight segments; anal ring with six anal ring setae.-----*Paralecanium* Ckll.
- bb. Adult female with legs and antennae, when present, all or in part rudimentary, one or both wanting.
- c. Adult female with body not greatly elongated, lateral margins strongly convex, never subparallel; anal cleft and opercula distinct.
- d. Body of adult female convex, sometimes approaching hemispherical, never spherical.
- e. Body of adult female convex, sometimes approaching hemispherical, fringed with long slender, spear-like marginal setae; legs and antennae wanting.--*Ericerus* Westw.
- ee. Body of adult female always convex, not approaching hemispherical, not fringed with slender spear-like marginal setae.
- f. Body of adult female with margin of dorsal aspect divided into twenty plates of which one is cephalic, one is about the anus, four are spiracular, and others are intermediate in position; legs are wanting, antennae tuberculate; anal ring with ten anal ring setae.-----  
*Houardia* Marchal.
- ff. Body of adult female with dorsal aspect never divided into plates; legs and antennae rudimentary, latter con-

- sisting of six segments; cuticle of dorsal aspect with minute distant alveola; anal ring with ten anal ring setae. -----*Toumeyella* Ckll.
- dd. Body of adult female spherical, never convex or subdepressed.
- e. Adult female with opercula not prominent and not dorsal in position.
- f. Cuticle of the dorsal aspect with minute distant alveolae; legs and antennae rudimentary or wanting; opercula obscure. -----*Akermes* Ckll.
- ff. Cuticle of dorsal aspect with large polygonal subadjacent alveolae; legs and antennae rudimentary.-----  
*Megasaissetia* Ckll.
- ee. Adult female with opercula prominent, swollen, dorsal in position; antennae and legs wanting; body with lateral portions infolded forming marsupium on each side.-----  
*Physokermes* Targ.
- cc. Adult female with body greatly elongated with lateral margins subparallel; anal cleft and opercula wanting; legs wanting; antennae represented by unsegmented tubercle on each side; mesothoracic spiracles sometimes located considerable distance cephalad of attachment of rostrum.-----*Aclerda* Sign.

**Exaeretopus**\*Newst.—The type species, *formiceticola* Newst., was collected in the nests of ants in England, the other species, *caricis* Ehrh., occurs on *Carex* and *Trisetum* in California.

**Luzulaspis** Ckll.—A single species, *luzulae* Dufour, is found in Europe on *Luzula*. A second species, *spinulosa* Leon., has been recorded from Argentina on *Atriplex*.

**Spermococcus** Giard.—This poorly defined genus includes a single species, *fallax* Giard, from France on the roots of grass.

**Lichtensia** Sign.—There are twelve species included in this genus. The following are found in America:—*argentata* Hemp. from Brazil; *colimensis* Ckll. from Mexico on ?*Celtis*; *crenata* Ckll. from Mexico on "Guanabano"; *lutea* Ckll. from Mexico on *Croton*, wild fig; *lycii* from New Mexico on "*Lycium* bush"; *mimosae* Towns. & Ckll. from Mexico on *Mimosa*; *parvula* Ckll. from Mexico on *Mimosa*; *simillima* Ckll. from Paraguay; *viburni* Sign. from France, England, Wales, Massachusetts on *Viburnum*, *Spiraea*, *Prinos*, *Hedera*; *zapotlana* Ckll. from Mexico on copal.

**Stotzia** Marchal.—This genus includes a single species, *striata* Marchal, from Algeria on *Ephedra*.

**Euphillipia** Berl. & Silv.—A single species, *olivina* Berl. & Silv., occurs on olive in Italy.

**Eriochitin** Mask.—A genus containing three species from New Zealand and India, *hispidus* Mask. from New Zealand on *Olearia*; *spinus* Mask. from New Zealand on *Atherosperma*, *Melicope*, *Elaeocarpus*, *Muhlenbeckia*, and *theae* Green from India on tea-plant.

**Mallococcus** Mask.—Two species are described, *sinensis* Mask. from China on *Callicarpa* and *lanigerus* Hemp. from Brazil.

**Austrolightensia** Ckll.—A single species, *hakearum* Fuller, occurs in Australia on *Hakea*.



**Eriopeltis Sign.**—Four species are included, *brachypodii* Giard on *Brachypodium*, *festucae* Fonsc. on *Festuca*, and *lichtensteini* Sign. on *Festuca* and other grasses from Europe. *Festuae* Fonsc. has been introduced into Nova Scotia, Eastern Canada, Maine, Illinois, Indiana, and Dakota. The fourth species, *coloradensis* Ckll. occurs in Colorado on grass.

**Fillipia Targ.**—A single species, *oleae* Costa, occurs on olives in Italy.

**Lecanopsis Targ.**—Four species are found in Europe upon the roots of grass, *Asperula*, and from the nests of *Lasius*. A single species, *lineolatae* King & Ckll. occurs in Massachusetts in the nests of ants.

**Ceronema Mask.**—A genus of five species, three from Australia, one from India and Japan, and one from Ceylon.

**Pseudophilippia Ckll.**—There is a single species, *quaintancii* Ckll., from Florida on pine.

**Pulvinella Hemp.**—A single species, *pulchella* Hemp., is described from Brazil on *Baccharis*.

**Pseudopulvinaria Atk.**—There is a single species from India, *sikkimensis* Atk. on *Cinchona*.

**Protopulvinaria Ckll.**—This genus includes two species, *convexa* Hemp. from Brazil on *Smilax*, is the type, and *longivalvata* Green from Ceylon.

**Philephedra Ckll.**—A single species, *ephedrae* Ckll. from New Mexico on *Ephedra*, is included. According to Ferris this species appears like a much elongated *Pulvinaria* in which spinæ and stigmatic clefts are wanting. The marginal setae are large and spine-like.

**Tectopulvinaria Hemp.**—A monotypic genus from Brazil with *albata* Hemp. as type occurs on *Veronia* and *Trichogonia*.

**Pulvinaria Targ.**—This genus contains over sixty species of which the following are found in America:—*acericola* Walsh & Riley from eastern and western United States on maple; *amygdali* Ckll. from New Mexico and Georgia on peach, apple, plum; *argentina* Leon. from Argentina on *Lycium*, *Fabiana*; *bigeloviae* Ckll. from California, Colorado on *Bigelovia*; *broadwayi* Ckll. from Grenada; *camelicola* Sign. from Europe, Australia, Japan, southern United States on *Camellia*, *Euonymus*, *Oncidium*, *Calanthe*; *cockerelli* King from Massachusetts on *Spiraea*, *Prinos*; *convexa* Hemp. from Brazil on *Smilax*; *cooleyi* King from Montana on *Picea*; *coulteri* Ckll. from Colorado on *Rosa*; *cupantiae* Ckll. from Jamaica on *Cupania*, *Bignonia*, guava; *dendrophthorae* Ckll. from Jamaica on *Dendrophthora*; *depressa* Hemp. from Brazil on *Miconia*; *ehrhorni* King from California on alder, willow; *eugeniae* Hemp. from Brazil on *Eugenia*; *ficus* Hemp. from Brazil on *Ficus*, *Psidium*, *Mangifera*, *Ixora*; *floccifera* Westw. from England, India, Canada, Massachusetts, Trinidad on *Augulosa*, *Lyasta*, *Camellia*, *Acalypha*, *Brassia*, *Phalus*; *grandis* Hemp. from Brazil on *Myrtaceae*; *hunteri* King from Kansas on maple, honey locust; *innumerabilis* Rathvon from Canada, United States on maple, many shade trees; *macluræ* Fitch from eastern United States, New Mexico on osage orange, sumac; *mammeae* Mask. from Hawaiian Islands, North America on *Mammea*, ferns, orange, coffee, plum; *occellentalis* Ckll. from Washington, British Columbia, Nova Scotia on currant, gooseberry, hawthorn, plum, pear, mountain ash, willow, poplar,

alder; ornata Hemp. from Brazil on *Ariabidaea*; plucheae Ehrh. from California on *Pluchea*; pruni Hunter from Kansas on plum, white elm; psidii Mask. from New Zealand, Japan, California, etc. on tea, plum, coffee, Citrus, etc.; pulchella Hemp. from Brazil on *Baccharis*; pyri-formis Ckll. from Trinidad, Jamaica, Grenada, Madeira on guava, cinnamon, etc.; rhois Ehrh. from California on *Rhus*; simulans Ckll. from Trinidad, Mexico; spinulosa Leon. from Argentina on *Atriplex*; tiliæ King & Ckll. from Massachusetts on *Tilia*; tinsleyi King from New Mexico on *Celtis*; tuberculatus Bouche from South America on *Malvaceae*; urbicola Ckll. from Jamaica, Barbadoes, Trinidad on *Capsicum*; viburni King from Canada on *Viburnum*; and vitis Linn. from Europe, United States on Grape. The two common eastern species of the United States can be separated as follows:—

## SPECIES OF PULVINARIA

- a. Cuticle of dorsum with distinct large subadjacent alveolæ; ovisac much longer than body of adult female and formed upon leaves of host-plant. Eastern United States on Maple.-----*acericola* W. & R.
- aa. Cuticle of dorsum with small distant alveolæ; ovisac not much longer than body of adult female and formed upon stems and branches of host-plant.—Eastern United States on maple, grape, elm, box elder, etc. -----*vitis* Linn.

**Takashasia Ckll.**—The type species, *japonica* Ckll. is from Japan on Mulberry. A second species, *jaliscensis* T. & W. Ckll. occurs in Mexico on *Rhus*(?). A third species, *citricola* Knw. has been described from Japan on Citrus.

**Ceroplastes Gray.**—This genus occurs in all parts of the world and includes over sixty species, of which over fifty are found in America. The following species are found in the United States:—*cirripediformis* Comst. from Florida, Louisiana, Mexico, West Indies on orange, quince, myrtle, persimmon, *Solanum*, *Eupatorium*, etc.; *cistudiformis* Towns. & Ckll. from Mexico, California on *Chrysis*, *Bignonia*, *Chrysanthemum*, *Cordia*, etc.; *floridensis* Comst. from southern United States, West Indies, Ceylon, Asia, Australia on Oleander, Citrus, quince, red bay, *Anona*, *Andromeda*, etc.; *irregularis* Ckll. from Mexico, New Mexico, Texas on *Atriplex*. Cockerell has proposed the following subgeneric groups for the genus *Ceroplastes*:—

1. "Typical *Ceroplastes*, with convex scales, in which the lateral plates are large and reach the lower margin; caudal horn (opercularia) usually moderate and directed posteriorly."
2. *Ceroplastina* Ckll.—Type, *C. lahillei* Ckll. "Wax abundant, pushing the plates to the dorsal surface; caudal horn mammiform, directed upwards. Wax of different individuals often confluent."
3. *Ceroplastidia* Ckll. Type *C. bruneri* Ckll. "In this group the wax of the several individuals is thick and always confluent, and the female has become high and narrow."

**Cardiococcus Ckll.**—Three species are included, two from Australia and the third, *umbonatus* Ckll., is from Mexico on wild guava.

**Vinsonia Sign.**—A single species, *stellifera* Westw., occurs commonly on many plants throughout tropical America and Ceylon.

**Ctenochiton Mask.**—There are fifteen species listed in Fernald's Catalogue. The following occur in America:—*aztectus* Towns. & Ckll. from Mexico on "Cafetilla cimarron" and *flavus* Maskell from Brazil on *Brachyglottis*, *Panax*, *Leptospermum*, *Elaeocarpus*.

**Laglosinia Ckll.**—A single species, *strachani* Ckll. from west Africa on *Anona*, is known.

**Alichtensia Ckll.**—There is a single species, *attenuata* Hemp., occurs in Brazil on *Baccharis*.

**Edwallia Hemp.**—A monotypic genus described from Brazil on *Eugenia* includes *rugosa* Hemp.

**Inglisia Mask.**—This genus includes eleven species. The following are from America:—*malvacearum* Ckll. from Mexico on *Malva*, *Hibiscus*, cotton and *vitrea* Ckll. from Trinidad on *Acacia*.

**Cryptinglisia Ckll.**—A single species, *lounsburyi* Ckll., occurs in Cape Colony on the roots of *Vitis*.

**Ceroplastodes Ckll.**—There are five species listed in Fernald's Catalogue. The following are from America:—*acaciae* Ckll. from Arizona, New Mexico on *Acacia*; *daleae* Ckll. from New Mexico on *Dalea*; and *dugesii* Sign. from Mexico on *Mimosa*.

**Parafairmairia Ckll.**—This genus includes a single species, *bipartita* Sign. from France on *Agropyrum*, *Mesembrianthemum*.

**Myxilecanium Beccari.**—This genus was based upon the presence of what was supposed to be a peculiar structure associated with the rostrum, a *crumena*, which is found in most if not all coccids. A single species is included, *kibarae* Beccari, from New Guinea on *Kibara*.

**Lechanochiton Mask.**—Two species from New Zealand are included in this genus.

**Neolecanium Ckll. & Parr.**—The following American species have been referred to this genus:—*chilaspidis* Ckll. from Mexico on *Chilopsis*; *cornuparvum* Thro from New York on *Magnolia*; *herreriae* Ckll. from Mexico on *Agave*; *imbricatum* Ckll. from Mexico, New Mexico on *Mimosa*; *leucaenae* Ckll. from Mexico on *Leucaena*, *Mimosa*; *manzanillense* Ckll. from Mexico; *perconvexum* Ckll. from Brazil on *Nectandra*; *plebeium* Ckll. from Mexico on *Ficus*; *sallei* Sign. from Mexico; *silveirai* Hemp. from Brazil on roots of grape; *tuberculatum* Towns. & Ckll. from Mexico on "cafetillo"; *urichi* Ckll. from Trinidad, Grenada, Brazil on *Smilax* and from nests of ants.

**Platinglisia Ckll.**—A single species, *noacki* Ckll., is recorded from Brazil on *Myrtaceae* and *Laurus*.

**Pseudokermes Ckll.**—Two species are referred to this genus; *armatus* Ckll. from Mexico on "Palo de gusano" and *nitens* Hemp. from Brazil on *Myrtus* and *Psidium*.

**Schizochlamidia Ckll.**—A single species from Mexico on *Mimosa*, *mexicana* Ckll. & Parr., is included.

**Alecanopsis Ckll.**—Maskell has described a single species, *filicum* Mask., from New South Wales on *Doodia*.

**Lecanium Burm.**—The species included here are those referred to the genus *Coccus* in Fernald's Catalogue. The following species occur in America:—*citricola* Campbell from California on *Citrus*; *flaveolus* Ckll. from New Mexico, Colorado on *Pilea*; *hesperidum* Linn. from all parts of the world on a great variety of plants; *incisus* King

from South America on nutmeg; longulum Dougl. from New Zealand, China, India, Mauritius, eastern United States, Mexico, West Indies, Hawaiian Islands on Psidium, Bambusa, Acacia, Citrus, Ficus. etc.; mangiferae Green from Ceylon, West Indies on Mango, cinnamon, nutmeg, bread-fruit, etc.; melaleuca Mask. from Australia, China, Massachusetts on Melaleuca; minimum Newst. from England, Mexico on Areca, Abutilon, fan-palm; nanus Ckll. from Trinidad on "Balata"; pseudo-hesperidum Ckll. from Canada on Cattleya; rubellus Ckll. from Jamaica; schini Ckll. from Mexico on "Nancem"; terminaliae Ckll. from Jamaica, Mexico on Terminalia; ventralis Ehrh. from California, Japan; viridis Green from Ceylon, Brazil, Mauritius on Cinchona, Citrus, Gardenia, tea, coffee, etc.

**Eulecanium Ckll.**—This genus contains over seventy species of which nearly fifty are found in America and of these forty-five are recorded from the United States. It is likely that a considerable number of these are synonyms. Six of the more common species can be separated by means of the following table which is based for the most part upon a table by Dietz and Morrison:—

## SPECIES OF EULECANIUM

- a. Adult female with median spina more than twice as long as either lateral spina; dorso-meson with row of dorsal tubercles extending cephalad from opercula; fringe setae four in number; operculum with outer and basal margins subequal and slightly longer than greatest width of operculum.—East of Rocky Mountains on peach, plum, apple, maple, etc. ----- *nigrofasciata* Perg.
- aa. Adult female with median spina always less than twice as long as either lateral spina; dorso-meson not with row of dorsal tubercles.
  - b. Each operculum distinctly more than twice as long as wide.
    - c. Alveolae promiscuously arranged, not in irregular transverse groups; species large, ten to thirteen millimeters long.—Eastern United States, Canada on apple, plum, linden, poplar, etc. ----- *caryae* Fitch.
    - cc. Alveolae arranged in irregular transverse groups; species small, four to six millimeters long.—Europe, Indiana, Oregon on apple, Crataegus. ----- *bituberculatum* Targ.
  - bb. Each operculum never more than twice as long as broad.
    - c. Lateral spinæ never twice as long as marginal setae of average length.
      - d. Alveolae arranged in more or less irregular bands.
        - e. Alveolae at least near middle of the dorsum large and arranged in single rows radiating from meson; cuticle nearly smooth, not wrinkled or roughened.—Eastern United States, Canada on arbor-vitæ. ----- *fletcheri* Ckll.
      - ee. Alveolae all subequal in size and small, arranged in irregular rows radiating from meson; cuticle irregularly roughened.—Europe, United States on Cornus, Ribes, Corylus, Pyrus, Tilia. ----- *corni* Bouche.

- dd. Alveolae promiscuously arranged, not in transverse rows; four fringe setae, mesal setae longer than lateral and arranged in two rows converging cephalad.—New York on blackberry. -----*obtusum* Thro.
- cc. Lateral spinae always twice or more as long as marginal setae of average length; alveolae promiscuously arranged; four fringe setae; arranged in single transverse row.—Eastern United States and Canada on *Quercus*.-----*quercifex* Fitch.

The species of the genus *Eulecanium* according to Sulc should be distributed among four genera. These genera are based upon the characters of the male, as follows:—

- a. Species reproducing avongenetically, males with two pairs of waxy abdominal filaments.
- b. Males with six pairs of ocellanae. -----*Eulecanium* Ckll.
- bb. Males with three pairs of ocellanae.
- c. Males with wings and halteres present, with pocket for hook of halteres. -----*Palaelecanium* Sulc.
- cc. Males with wings and without halteres and pockets for hooks of halteres. -----*Sphaerolecanium* Sulc.
- aa. Species reproducing parthenogenetically, males not known.-----*Parthenolecanium* Sulc.

Sulc refers *caprae* L., *douglasi* Sulc, *ciliatum* Newst., and *alni* Mod. to *Eulecanium*; *bituberculatum* Targ. to *Palaeolecanium*; *prunastri* Fons. to *Sphaerolecanium*; and *coryli* Linn. and *persicae* Geoff. to *Parthenolecanium*.

**Globulicoccus Lindinger.**—This name was proposed by Lindinger as of subgeneric rank to include *Eulecanium fuscum* Gmel. from Europe on oak, also *caprae* Linn. from Europe, Nova Scotia on *Salix*, poplar, linden, *Pyrus*, *Prunus*, etc.

**Mesolecanium Ckll.**—An American genus of thirteen species. One of these, *phoradendri* Ckll., occurs in Arizona on *Phoradendron*, the other species are limited to Mexico and Brazil.

**Stictolecanium Ckll.**—This genus includes a single species, *ornatum* Hemp. from Brazil on *Eugenia*.

**Saissetia Depl.**—This genus contains over twenty species, several of them of wide distribution. The three more important species occurring in the United States can be separated by the following table based upon the analysis of Thro:—

#### SPECIES OF SAISSETIA

- a. Fringe setae eight in number.
- b. Opercula with outer margins distinctly longer than basal margins, outer angle broadly rounded, fringe setae convergent toward meson.—Europe, South Africa, Mauritius, Ceylon, China, Japan, Australia, New Zealand, Hawaiian Islands, Brazil, Mexico, West Indies, United States on orange, apple, pear, plum, olive, apricot, etc. -----*oleae* Bern.

- bb. Opercula with outer margins subequal in length with basil margins, outer angle not rounded, but angulate, fringe setae in transverse row.—Europe, United States, Mexico, West Indies, Brazil, Australia, etc. on ferns, Oleander, Camellia, etc.-----  
*hemisphaericum* Targ.
- aa. Fringe setae four in number; opercula with outer and basal margins subequal, outer angle angulate, fringe setae in transverse row.—Europe, United States, Australia, Jamaica, etc. on ferns.-----  
*filicum* Bdv.

**Platysaissetia** Ckll.—A single species, *castilloae* Ckll., from Mexico on *Castilleja* is included.

**Cryptes** Mask.—There is a single Australian species, *baccatus* Mask., occurring on several species of *Acacia*.

**Hemilecanium** Newst.—Two species, *imbricans* Green from West Africa on *Theobroma* and from India on *Ficus* and *recurvatum* Newst. from Upper Congo, Africa from hollow stems of *Plectronia*, are included.

**Eucalymnatus** Ckll.—A genus containing the following four species:—*brunfelsiae* Hemp. from Brazil on *Brunfelsia*, *Laurus*; *gracilis* Hemp. from Brazil on *Sapindaceae*; *perforatus* Newst. from England, Australia, Hawaiian Islands, Florida, Iowa, Colorado, California; and *tesselatus* Sign. from England, France, Australia, Mauritius, Hawaiian Islands, Ceylon, Jamaica on *Laurus*, *Sapindus*, *lignum vitae*, palms, ferns, etc.

**Paralecanium** Ckll.—This genus contains seven species, one, *marianum* Ckll. from Brazil, and the others from Australia, Ceylon, and China.

**Ericerus** Westw.—This genus includes the single species, *pe-la* Westw., which is a native of China and Japan where it feeds upon *Ligustrum*, *Rhus*, *Hibiscus*, and *Fraxinus*. The adult females are collected by the Chinese and raised in order to secure the males in large numbers, which produce a considerable quantity of wax. This is collected in June and mixed with tallow and used in the preparation of candles which are burned in the sanctuaries. The Chinese not only cultivate the plants upon which the females are grown but transport them a long distance through dangerous mountain passes from Western China to the regions where the wax is produced. The pure wax is clear white in color like the best quality of paraffin and very hard, but not brittle. The wax harvested each year by the Chinese, according to Sassaki, is worth over two hundred thousand dollars. Paraffin candles are used at the present time instead of the candles made from the coccid wax, except on very state occasions.

**Houardia** Marchal.—A single species, *troglodytes* Marchal, from Senegal, Africa, is found in the galleries in the branches of *Balanites* where they are attended by ants.

**Toumeyella** Ckll.—This genus contains the following species: *magnoliarum* Ckll. from California, Ohio on *Magnolia*, *Daphne*, *Virginia creeper*; *mirabilis* Ckll. from Arizona, Mexico on *Mesquite*; *parvicornis* Ckll. from Florida on pine; *pini* King from Canada, New York on pine; *quadrifasciata* Ckll. from New Mexico on *Robinia*; *sonorensis* Ckll. &

Parr. from Mexico on *Beloperone*; and *turgida* Ckll. from Florida on *Magnolia*.

**Akermes Ckll.**—A genus containing ten species from Mexico, South America, Australia, and India.

**Megasalssetia Ckll.**—Two species, *inflata* Ckll. & Parr. from Mexico on "Laurel-tree" and *brasiliensis* Hemp. from Brazil, are known.

**Physokermes Targ.**—A genus containing the following five species:—*coloradensis* Ckll. from Colorado on spruce, *Pinus*; *concolor* Coleman from California on *Abies*; *insignicola* Craw from California on *Pinus*; *piceae* Schr. from Europe, New York on *Abies*, *Pinus*; *taxifoliae* Coleman from California on *Pseudotsuga*.

**Aclerda Sign.**—There are eleven species included in this genus. The following are recorded from America:—*ariditalis* Ferris from New Mexico on a perennial grass; *californica* Ehrh. from California, Kansas, New Mexico on *Andropogon*; *obscura* Parr. from Kansas on *Andropogon*, *Sporobolus*; and *tokionis* Ckll. from California, Japan on bamboo. According to Ferris the marginal spines in *californica* Ehrh. are acorn-shaped, rounded at the tip in *ariditalis* Ferris, while the marginal spines appear to be entirely wanting in *obscura* Parr.

## CHAPTER XVI

### SUBFAMILY ASTEROLECANIINAE

#### *The Ceravitreous Coccids*

The body of the adult female is round, oval, or elongate oval in outline. The dorsal aspect is convex or strongly convex and the ventral aspect is flat. The lateral margins are sometimes convex, frequently with a marginal rim and the two ends are convexly rounded or the caudal end is truncate or produced. The segmentation is very indistinct or not indicated. The caudal end of the body is not inflated and the cephalic and lateral margins are not provided with a keel. The antennae are normal in form, consist of four to six segments or each is reduced to a single rudimentary tubercle, and are articulated to the ventral aspect of the head. The eyes are wanting. The mouth-parts, rostrum and rostralis, are present, the rostrum consists of a single segment. The legs are rudimentary, mere tubercles or wanting. The spiracles of the mesothorax and metathorax are normal in size and ventral in position. The mesothoracic spiracles are never located near the anus. The abdominal spiracles are always wanting. The stigmatic clefts may be present or wanting, when present, they are usually provided with one or two spinac with canellae and spiracerores. The abdomen is about as long as the head and thorax together or longer. It is usually more or less convex on the dorsal aspect and flat on the ventral. The lateral margins are either sharply defined or obscure or wanting. The caudal end is rounded or truncate or more or less produced or emarginate, but never with a mesal cleft and opercula. All the segments are fully exposed and similar in appearance with or without coriae between them, none are retracted to form a marsupium. The abdomen is never provided with an anal cleft and opercula. The anal ring is usually present and located at the cephalic end of a short retracted anal tube and provided with six, eight, twelve, four, two, or without anal ring setae. The anal lobes and the anal setae are usually present, very different in size and form in the different genera. The caudal abdominal segment can not be identified. The body is provided with cerores, is never provided with pilacerores, and usually with octacerores, and sometimes with ceratube. The body is never enclosed in a resinous cell with three adjacent openings or covered by a scale with or without exuviae but is usually covered by a test of wax, very diverse in form, varying from a thin glassy sheet of wax with a glassy fringe to a rather dense thick mass of wax or with the body naked. Insects sometimes form depressions or galls on plants. The rectum is never provided with a long glassy tube of wax or with a chitinized rectal tube bearing rings of anacerores. The body even if naked is not gall-like in form.



The female nymphs of all stages are provided with a rostrum and a rostralis. The three pairs of legs are present in the first nymphal stage and in the second nymphal stage of some species and, when present, are similar in form. The profemora are never greatly enlarged and the prothoracic legs are never fitted for digging. The abdomen is usually provided with octacerores, frequently present when wanting in the adult, also provided with an anal ring and anal ring setae, the number of anal ring setae variable, and with anal lobes and anal setae. An anal cleft, opercula, and pilacerores are never present; ceratubae are sometimes present. The caudal end of the rectum is not chitinized, forming a rectal tube provided with one or more rings of anacerores excreting a long glassy tube of wax. The caudal abdominal segment is usually distinguishable and bears the anal setae.

The males have four ocellanae, two dorsal and two ventral. The abdomen is not provided with long lateral filaments or tufts of wax filaments or provided with long thread-like caudal filaments. The stylus is long and slender.

This group was first recognized as a tribe by Targioni Tozzetti when he proposed his generic division *Lecanodiaspis* and the tribal name *Lecanodiaspidites* to include it. This subdivision was rejected by Signoret and Comstock. It was later adopted as a subdivision of his *Lecaniinae* by Maskell and as a subfamily by Cockerell in 1896 under the name of *Asterolecaniinae*. While it was rejected by Green in 1896 in the first volume of his "*Coccidae of Ceylon*," he recognized it in the fourth volume published in 1909 after he had studied the Ceylonese species. There are less than thirty-five species of *Asterolecaniinae* listed in Fernald's Catalogue from America. The subfamily is not limited in its distribution, since species are found in practically all parts of the world.

While this subfamily is apparently a well founded homogenous group, all its genera do not offer an abundance of characters for combining them into distinctive units. The most characteristic feature is the presence of octacerores or the so called 8-shaped dermal glands. These are formed by the close apposition or arrangement of the cerores in pairs. The adjacent portions of the margins of the pairs of cerores are often round, but frequently more or less flattened, emphasizing the resemblance to a figure 8. In the genus *Asterolecanium* there is one or two rows of octacerores arranged around the margin of the body. It is from these octacerores that is excreted the characteristic straight or curved glassy threads of wax. This forms a margin which is a thin homogenous sheet produced by a partial or entire fusion of the adjacent threads. The covering of wax may be opaque and have a distinct waxy

consistency, or the test may be dense and of considerable extent bearing horn-like projections. The test is apparently, no matter how extensive and complex, freely separable from the body of the adult female. The species that form galls, as those belonging to the genera *Amorphococcus* and *Frenchia*, and those that are attended by ants have the body naked. The octacerores, while usually confined to the dorsal aspect, are in a few species situated upon the ventral aspect. They may be wanting in the adult female, but are generally a characteristic feature of the first nymphal stage where they are usually arranged in longitudinal rows. There is considerable variation in the number and arrangement of the octacerores, not only in the adult female but in the nymphal stage. The test, in which there is an opening for the escape of the young, is designated the ovisac by Newstead.

There are small tubes extending through the cuticle into the body cavity which have been designated by Green as the tubular glands or tubular dermal glands. He believes that the homogenous part of the test is excreted from these. The cuticular tubes are evidently similar to the tubes found in certain naked lecaniids and although characteristic in form for this group are undoubtedly homologous with the ceratubae of the diaspidids.

While the species of certain genera form galls that are characteristic in form, other species, as certain of those of the genus *Asterolecanium*, form prominent crater-like depressions in the bark in which the insect rests.

The antennae in the adult female are variable in development, they may be fully formed and consist of eight or nine segments or of only a few segments, four or less, or be completely wanting. They are attached, when present, to the ventral aspect of the head some distance from the lateral margin. The antennae in the first nymphal stage consist of six segments.

The legs are usually wanting or rudimentary in the adult female, frequently only represented by mere hooks, but are well developed in *Olifiella*. In the first nymphal stage and also in the second in at least certain genera the legs are present and normal in size, form, and arrangement of parts.

The extent of the thorax, since the legs are wanting in the adult female in most species, can be determined only by the presence of the thoracic spiracles. They are normal in size. The mesothoracic spiracles are located on a transverse line drawn through the rostrum and the metathoracic spiracles in line with and

a short distance caudad of the mesothoracic spiracles. There are canellae with spiracerores which extend from the spiracles to the margin of the body where there are one or two prominent spinae in *Lecanodiaspis* and *Anomalococcus*. The figures of some authors of other genera show spiracerores but the absence of spinae.

The dorsal surface of the abdomen in certain genera bears some cuticular pitted or sieve-like plates, which are known as the cribiform plates. These plates as dorsal structures are not found outside the subfamily *Asterolecaniinae*. Ferris has noted the presence of cribiform plates in *Kuwanina* Cockerell, but these plates are confined to the ventral aspect of the abdomen. The cribiform plates are the madreporiform bodies of Comstock. The function of these plates is unknown, their openings may be cerores. There are six cribiform plates in *Lecanodiaspis*, three on each side distant from the meson; two groups in *Cerococcus*, one on each side near the anal ring, each group consisting of four plates; a single large group extending transversely in an irregular row near the middle of the abdomen and consisting of one hundred to one hundred and fifty cribiform plates. The surface of the plate is cup-shaped in *Cerococcus* and flat in the other genera.

The caudal end of the abdomen may be only slightly indented or emarginate or it may be deeply indented, in such cases it is said to be deeply cleft. Such an emargination is different from the anal cleft of the lecaniids, but is more like the emargination of the eriococcids. The emargination appears to be formed by the projecting anal lobes. That these structures are anal lobes is shown from the almost universal presence of anal setae, the caudal setae of Green, which in some species are very large and prominent.

The caudal end of the alimentary canal, the anus and anal ring, are invaginated and form the bottom of a short tube or pocket, the anal tube, which resembles somewhat the anal tube of the lecaniids. The form and extent of this tube varies with the genus. The caudal end of the anal tube is supported on the dorsal side by a transverse strongly chitinated plate, the dorsal lip. This varies from a simple transverse plate in *Asterolecanium* to a shield-shaped plate in *Cerococcus* and an irregular crescentic or subrescencic plate with the caudal margin emarginate in *Lecanodiaspis*. In this latter genus there is a prominent dumb-bell-shaped thickening on the ventral aspect caudad of the opening of the anal tube.

The number of anal ring setae is frequently not constant even for the same genus. The normal number in *Asterolecanium* is six

but may be reduced to two or even all may be wanting. There are eight to twelve anal ring setae in *Lecaniodiaspis*, ten to sixteen in *Anomalococcus*, eight in *Cerococcus*, wanting in *Pollinia*, and eight in *Amorphococcus*.

The eggs are deposited by the female in the test under the body. The first stage nymphs are elongate, oval in outline with the cephalic end bluntly rounded and the caudal end pointed. The legs are present and normal in form. The antennae consist typically of six segments. The spinae, if present in the adult, are also present in the nymphs. The dorsal lip and dermal plate, if characteristic of the adult may be represented in the nymphs. The octacerores are frequently more numerous and arranged in two to six longitudinal rows. The anal ring is present and provided typically with six anal ring setae. The anal lobes and anal setae are usually present, but vary greatly in size and prominence in the different genera. The female nymphs molt twice. The male nymphs of the second stage may be provided with octacerores.

#### GENERA OF ASTEROLECANIINAE

- a. Abdomen of adult female with dorsal cribiform plates.
  - b. Antennae of adult female well developed, consisting of four to nine segments; spinae present at least in nymphs; anal lobes of adult female small.
    - c. Spinae large and distinct in adult female; body of insect enclosed in complete test; anal ring of adult female with eight to twelve anal ring setae; abdomen with two rows of cribiform plates. -----*Lecaniodiaspis* Targ.
    - cc. Spinae wanting in adult female, distinct in nymphal stages; body of insect not enclosed in test, naked; anal ring of adult female with ten to sixteen anal ring setae; abdomen with large transverse group of cribiform plates near middle of the dorsum. -----*Anomalococcus* Green.
  - bb. Antennae of adult female rudimentary, always consisting of less than four segments; spinae never present in any stage; anal lobes of adult female large and distinct with shield-shaped dorsal lip between them; body of insect enclosed in dense test of wax with or without projections; anal ring of adult female with eight anal ring setae; abdomen with two groups of cribiform plates, each cephalo-laterad of the dorsal lip. -----*Cerococcus* Comst.
- aa. Abdomen of adult female never with dorsal cribiform plates.
  - b. Adult female living free, never enclosed in woody gall.
    - c. Body of adult female and first stage nymph always with octacerores.
    - d. Body of adult female always with peripheral band of dorsal octacerores, dorsum sometimes with other octacerores than

peripheral band; anal ring normally with six anal ring setae, but may have two, four, or none; anal lobes and anal setae small, sometimes wanting; first nymphal stage with peripheral band of dorsal octacerores, antennae with six segments, and anal lobes and anal setae distinct.....

*Asterolecanium* Targ.

- dd. Body of adult female never with peripheral band of dorsal octacerores.

e. Dorsum of adult female with mesal band of octacerores; anal ring obscure and apparently without anal ring setae; first stage nymph with antennae of four segments, without anal lobes and anal setae, without anal ring setae, and with peripheral band of dorsal octacerores.....

*Callococcus* Ferris

ee. Dorsum of adult female with numerous octacerores, but not arranged in peripheral or mesal row; anal ring small and obscure; first stage nymph with antennae of five segments, anal lobes and anal setae small, anal ring small with four minute anal ring setae, and with four dorsal longitudinal rows of octacerores.....

*Mycetococcus* Ferris.

- cc. Body of adult female never with dorsal octacerores.

d. Adult female without prominent anal lobes or anal setae, if present, small; anal ring with eight anal ring setae or without; first stage nymph with four longitudinal rows of octacerores, antennae with six segments, and anal ring with six anal ring setae.....

*Pollinia* Targ.

- dd. Adult female with prominent anal lobes, with or without anal setae; first stage nymph unknown or octacerores unidentified.

e. Adult female with prominent anal lobes bearing large anal setae, longer than anal lobes; anal ring with eight anal ring setae and without shield-shaped dorsal lip; first stage nymphs with four longitudinal rows of cuticular circles, octacerores not identified, antennae with eight or nine segments, anal ring with anal ring setae.....

*Amelococcus* Marchal.

ee. Adult female with large anal lobes bearing several small setae, none as long as anal lobes, without distinct anal setae; anal ring with six anal ring setae and with prominent shield-shaped dorsal lip between anal lobes; antennae atrophied, apparently with seven segments; nymphal stages unknown. ....

*Olliffia* Fuller.

- bb. Adult female never living free, always enclosed in a woody gall.

c. Adult female with antennae of six segments and with distinct legs; dorsal surface of adult female with numerous octacerores. ....

*Olliffia* Ckll.

- cc. Adult female with antennae and legs wanting, antennae at most only tuberculate; dorsal surface of adult female without octacerores.

- d. Nymphs of first stage with four rows of octacerores, antennae with six segments; adult female with anal ring with eight anal ring setae; thorax with four groups of spiracerores. -----*Amorphococcus* Green.
- dd. Nymphs of first stage with six rows of octacerores, antennae with six or seven segments; adult female apparently without anal ring and anal ring setae, thorax apparently without groups of spiracerores. -----*Frenchia* Maskell.

**Lecaniodiaspis Targ.**—There are less than twenty-five described species in this genus. The following have been reported from America:—*celtidis* Kkll. from Texas, Ohio on *Celtis*; *dendrobit* Dougl. from British Guiana on *Dendrobium*; *manihotis* Towns. from Mexico on *Manihot*; *prosoptidis* Mask. from Arizona on *Prosoptis*; *pruinosa* Hunter from Kansas on elm; *radiata* Kkll. from Mexico; *rufescens* Kkll. from Arizona, California on *Adenostoma*, *Fouquiera*; *rugosa* Hemp. from Brazil; *tessalata* Kkll. from Georgia, Florida on *Disospyros*, hickory; and *yuccae* Towns. from New Mexico on *Yucca*, *Dasyllirion*, *Parthenium*.

**Anomalacoccus Green.**—This genus includes a single species, *cremastogastri* Green, from Ceylon from the nests of ants.

**Cerococcus Comst.**—About ten species belong to this genus. There is only a single American species, *quercus* Comst., from California and Arizona on *Quercus*.

**Asterolecanium Targ.**—There are twenty-seven species listed in Fernald's Catalogue and a considerable number of species have been described since its publication. The following species occur in America:—*aureum* Bdv. from Europe, West Indies on *Calathaea*, *Oncidium*; *bambusae* Bdv. from Brazil, Grenada, West Indies, Mexico, Algeria, Ceylon, Mauritius on bamboo; *epidendri* Bouche from Europe, Jamaica, Trinidad on *Epidendrium*, *Oncidium*, *Angraecum*, *Broughtonia*; *fimbriatum* Fonsc. from Europe, Australia, British Guiana on *Leptospermum*, *Coronilla*; *miliaris* Bdv. from Brazil, Jamaica, Trinidad, Algeria, Mauritius on bamboo; *palmae* Kkll. from Jamaica on coconut-palm; *pustulans* Kkll. from Florida, Mexico, West Indies, British Guiana on fig, oleander, mango, peach, *Hibiscus*, *Anona*, etc.; *quercicola* Bouche from Europe, eastern United States on oak; *townsendi* Kkll. from Mexico on "Gusima"; *urichi* Kkll. from Trinidad, Grenada on palms, *Bactris*; *variolosum* Ratz. from Europe, eastern United States, Canada on oak; and *viridulum* Kkll. from Argentine Republic.

**Callococcus Ferris.**—A single species, *pulchellus* Maskell, from Australia.

**Mycetococcus Ferris.**—Two American species are included, *ehrhorni* Kkll. from California on oak and *corticis* Towns. & Kkll. from Mexico on oak. These species were previously referred to *Cerococcus*.

**Pollinia Targ.**—A small genus of less than five species, the type species, *pollini* Costa, has been introduced into California on olive.

**Amelococcus Marchal.**—A monotypical genus occurring in Madagascar on *Euphorbia*. The single species, *allaudi* Marchal, was considered as an eriococcid. The form of the body, the anal lobes, the position of the anal ring, the four longitudinal rows of circular tuber-

cles, and the enveloping of the female in a sac open only at the posterior end are responsible for its location in this subfamily.

**Olliffia Fuller.**—There is a single species, *eucalypti* Fuller, from West Australia on *Eucalyptus*. The genus is generally placed in the Eriococcinae. The form of the anal lobes and the shield-shaped dorsal lip, similar to that found in *Cerococcus*, suggested its present location and the possibility that it may not be an adult female that is figured. The nymphal stages are unknown.

**Olliffiella Ckll.**—A single species, *cristicola* Ckll., from New Mexico, where it produces galls on the leaves of oak is included. The presence of octacerores suggested its present location. This genus was originally associated with the Australian gall making coccids of the genus *Cylindrococcus* and *Sphaerococcus* and later with the Eriococcinae. The tarsi consist of a single segment according to Ferris and not two as described by Cockerell. The antennae of the adult female consists of five to six segments and of the first nymphal stage of six segments. The anal ring of the adult female is without anal ring setae and the first nymphal stage is provided with six anal ring setae. Ferris records the presence of ventral octacerores and considers this genus as related to *Kermes*.

**Amorphococcus Green.**—This is a Ceylonese genus, including a single species, *mesuae* Green, on *Mesua*. Ferris has referred *leptospermi* Maskell, described as a species of *Sphaerococcus* from New South Wales on *Leptospermum* to this genus.

**Frenchia Maskell.**—Two species, *casuarinae* Maskell and *semioculata* Maskell from Australia on *Casuarina*, belong to this genus. Its present position was suggested as probable by Green.

## CHAPTER XVII

### SUBFAMILY KERMESHINAE

#### *The Pseudogall Coccids*

The body of the adult female is rotund, globular, not insect-like. It resembles a gall or berry and is either uniformly smooth or subdivided by broad shallow furrows. The cephalic, lateral, and caudal margins can not be identified. The coriae are uniformly chitinated and are similarly colored with the segments so that the segmentation is obliterated. The caudal end of the body is not inflated and the cephalic and lateral margins are not provided with a keel. The antennae are distinct, consist of six segments or are greatly reduced and rudimentary or are wanting, when present, are articulated to the ventral aspect of the head. The mouth-parts, rostrum and rostralis, are present but inconspicuous, the rostrum consists of two segments. The legs are present. They are subequal in length, rudimentary, or wanting. The profemora are never enlarged and the prothoracic legs are never fitted for digging. The trochantal-femoral and tibio-tarsal sutures of all normally formed legs are always distinct. The spiracles of the mesothorax and metathorax are small and inconspicuous and are ventral in position. The mesothoracic spiracles are never located near the anus. The abdominal spiracles are always wanting. The stigmatic clefts, spinae, and canellae are wanting. The extent of the head, thorax, and abdomen can not be determined. The ventral aspect of the body is depressed or concave to fit the surface of the host-plant, the other aspects are uniformly convex without division between them. The caudal end is uniformly convex. The segmentation of the abdomen can not be determined, but no part is invaginated to form a marsupium. The abdomen is never provided with an anal cleft and opercula. The anal ring and anal ring setae are wanting. The anal lobes are rarely present. The caudal abdominal segment can not be identified. The body is provided with ceriores none of which are octaceriores or pilaceriores. Ceratubae are sometimes present. The body is never enclosed in a resinous cell with three adjacent openings or covered by a scale with or without exuviae. The surface of the body, dorsal and particularly the ventral aspect, sometimes bears a slight covering of mealy or pulverulent wax. The body is usually naked and gall-like, rarely setaceous or slightly covered with seta-like threads of wax.

The female nymphs of all stages are provided with a rostrum and rostralis. The three pairs of legs are present in the first nymphal stage and are similar in form. The profemora are never greatly enlarged and the prothoracic legs are never fitted for digging. The body is never provided with an anal cleft and opercula, octaceriores, or pila-



cerores. The anal ring is distinct in the first nymphal stage and bears six anal ring setae. The anal lobes are distinct and each bears a single large anal seta. The caudal end of the rectum is not strongly chitinized, forming a rectal tube with one or more rings of anacerores excreting a long glassy tube of wax. The caudal abdominal segment is not short, narrow, and projecting.

The male has ten ocellanae, five on each side of the head. The abdomen is not provided with long lateral filaments or with tufts of long wax filaments, but bears two long caudal filaments. The stylus is short.

This subfamily contains a single genus, *Kermes*, and about forty species all of which with only two exceptions feed upon various species of oak. The single species found in Australia feeds upon *Acacia* and one of the Japanese species feeds upon *Quercus* and *Rhamnus*. The great majority of the species are found in Europe and America, with the larger number in the latter country.

One of the species, *Kermes ilicis*, is found abundantly upon a small species of live oak, *Quercus coccifera*, in southern Europe. It has been used as a dye from the earliest times for dyeing cloth blood red or crimson. The Phoenecians before the time of Moses used it as a dye and it was also used in ancient times by the Greeks, Romans, Arabians, and Persians. The latter people knew it under the name of *Kermes*. The crimson of the Greeks and Romans was produced with this color and the imperishable reds of the Brussels and other Flemish tapestries were produced with this same dye. It was universally used before the discovery of the new world and the introduction of cochineal from America by the Spaniards.

The adult females, which have the body naked or rarely covered with a slight bloom of mealy wax or sparsely pubescent, are usually attached to the smaller branches of young trees. The insects vary greatly in color, brownish or blackish or dirty yellowish, with or without darker markings, which are generally arranged as light or dark transverse bands. The portion of the body applied to the plant is flat or concave or irregular so that the insect fits securely against the bark of the branch. The most of the species are globular or subglobular in form and resemble very closely the minute smooth bullet galls found on the stems of the same trees. The female of *Kermes* resembles berries or galls so closely in general appearance that they are frequently regarded or mistaken for galls and not as the bodies of insects. This resemblance is enhanced through the fixation of the insects in the angles or near buds, where the bullet galls are usually located. The species of this

subfamily have been defined in all the diagnoses of the subfamilies as body naked and gall-like in form. It is not only unwise but improper to designate the body of any of the naked coccids as the scale as is frequently done by certain writers. The body in some species is slightly longitudinally or transversely constricted at middle or furrowed, so that it is more or less reniform. A few species resemble certain of the naked lecaniids, others are elongate and more swollen. The species also vary in that some occur singly or at most in groups of three or four upon a branch while others occur in such numbers as to completely cover a considerable portion of the stem.

The appendages are present on the ventral aspect of the adult female. The rostrum consists of two segments. The antennae and legs of the adult female may be well developed. The former consisting of six or less segments, or they may be rudimentary or wanting. The thoracic spiracles are present, normal in position, and surrounded by numerous spiraceroses. The anal lobes and the anal setae are wanting as well as the anal ring and the anal ring setae. The ventral aspect of the body may bear numerous ceroses from which is excreted the white wax located between the body of the female and the host-plant, but this wax is generally not exposed until the insect is removed. The exposed surface of the body may bear ceroses from which is excreted the powdery wax which is spread over its surface. Some species bear numerous short ceratubae. The genus *Kermes* was originally associated with the lecaniids. In order to justify this location, it was necessary to show the presence of an anal cleft and opercula. Some writers have indicated the presence of such structures, but these structures are wanting in most species and it is very doubtful if they or any other structures similar to them occur in any species. Maskell in defining his group *Hemmicoccidinae*, which is the equivalent of the *Kermesinae*, makes the following statements:—"Adult female exhibiting the anal cleft and the lobes of the *Lecanidae*; naked or covered. Larvae presenting at the extremity of the abdomen the anal tubercles of the *Coccidae*. From the foregoing characters the group is very evidently intermediate between the *Lecanids* and *Coccids*."

While the adult females of certain species of *Kermes* do show a superficial resemblance to the naked lecaniids, the first stage nymphs show clearly their true relationship. They are distinctly eriococcid, not only in general appearance, but in structure. The

body is elongate oval in outline. The antennae are elongate and consist of six segments which bear numerous setae. The mouth-parts are well developed and located between the prothoracic legs. The legs, which are similar in size, are long and slender and project for some distance beyond the lateral margins of the body. They are provided with long claws and with two tarsal and two ungual digitules. The caudal end of the body is provided with two anal lobes, each of which bears a large anal seta and usually several much shorter setae. The anal ring is distinct and located cephalad of the anal lobes. It bears anal ring setae, typically six, and is sometimes divided into two parts. The entire lateral margin is fringed with marginal setae. In a few species the marginal setae are conical in form. There are four longitudinal rows of similar setae on the dorsum making six longitudinal rows of dorsal setae, while Signoret figures conical marginal setae in some of the European species, arranged so as to form two disconnected rows on each side, and six dorsal longitudinal rows, making eight in all. This gives an arrangement similar to that found in certain young eriococcids. There are cerata arranged in rows between the conical setae. Practically nothing is known regarding the second stage female nymphs. Maskell states that they are semi-globular and yellow or brown. The number of molts in the female has not been determined.

Observations by one of my students, J. Howard Gage, would suggest that the second nymphal stage may be wanting. The young nymphs emerge from the eggs in the fall and creep into minute cracks and crevices near the ends of the smaller twigs, covering themselves with curly threads of wax. They remain as minute pinkish specks in such situations without change until spring. As the weather gets warm they leave their place of concealment and covering of wax. After the buds have opened and the new twigs have been formed and are about an inch or two in length, the nymphs migrate out onto the tender branches and onto the petiole and surface of the leaf. Those on the branches and petioles attach themselves, but most of those on the leaves migrate back onto the branches and petioles. Early in June the body of the insect is swollen, globular, and is beginning to assume the characteristic form of that of the adult female. They are still whitish or greenish in color and do not yet have the brownish color of the adults. The growth after their emergence from hibernation is a very gradual one and if molts occurred, although par-

ticular care was taken to observe them, none was noted. If the body of the dried female is opened in the fall, it will be found completely filled with white empty egg shells. The young nymphs resemble miniature mealy bugs.

The adult males according to Signoret resemble the males of the Eriococcinae. They complete their final transformations in small white felt-like cocoons of wax attached to the ventral surface of the leaves. Comstock figures the cocoons of the males of galliformis Riley on the underside of the leaves. Nothing of their early development appears to be known. The head bears ten ocellanae, five on each side of the head. The dorsal and ventral pairs are much larger than the others. The antennae are very long and consist of ten segments. The wings are long and the halteres are distinct with distinct hooks. The legs are long and slender, the femur and tibia are subequal and each is much longer than the tarsus which bears a simple claw and two tarsal and two ungual digitules. The abdomen is elongate. The stylus is about as broad as long and the caudal end bears two long thread-like projections, longer than the entire body and evidently formed of wax.

**Kermes Boit.**—A considerable number of American species of the genus Kermes have been described. These in most cases are based upon the form and color of the gall-like or berry-like body of the adult female. The following table for the separation of these species is based upon the tables and descriptions of Cockerell, King, and Ehrhorn. The table must be used with caution, unfortunately it includes practically all the information given in the various descriptions. In every case where the body of the insect is referred to, the body of the adult female is meant.

## SPECIES OF KERMES

- a. Body either sparsely pubescent or covered with wax.
  - b. Body sparsely pubescent and naked; 3.6 mm. broad by 3 mm. high; light brown with obscure and suffused dark brown bands, surface shining, with concolorous specks, without dark spots or pits.—Massachusetts, Ohio, Indiana, Kansas on *Quercus macrocarpa*. ----- *pubescens* Bogue.
  - bb. Body without setae but covered with wax.
    - c. Body covered, except on middle of back, with snow-white powdery wax; 4.5 mm. broad and 3 mm. high; resembles small species of *Lecanium* in shape; dark sepia brown in color and irregularly marbled with black and pale ochreous, beset with numerous minute dark spots.—Massachusetts on *Quercus alba*.----- *nivalis* King & Ckll.
    - cc. Body covered with wax, but never snowy white.
    - d. Body over three millimeters in diameter.

- e. Body 5 mm. in diameter, color mahogany brown, shining, with three distinct dark brown lines across dorsum, black spots apparently wanting.—California on *Quercus chrysolepis*. ----- *shastensis* Ehrh.
- ee. Body 4 to 4.5 mm. in diameter; color brown, shining, dotted with black spots.—Arizona on *Quercus*.-----  
*ceriferus* Ehrh.
- dd. Body three millimeters in diameter; color dark gray, dull not shining, with fine black lines upon dark yellowish brown surface and with depressed darker spots.—Massachusetts on *Quercus ilicifolia*. ----- *perryi* King.
- aa. Body always naked, never sparsely setaceous or covered with wax.
- b. Insects of large size, 7 to 10 mm. in diameter.
  - c. Body with transverse furrows and with rounded protuberances, with three protuberances, one mesal in each transverse row; 8 mm. long and 7.5 mm. broad; color white with dark brown mottling, usually with white dorsal band.—Colorado, New Mexico on *Quercus undulata*. ----- *gilletti* Kkll.
  - cc. Body not with transverse furrows and without protuberances.
    - d. Body globular, 10 mm. diameter; surface dull, peppered or mottled irregularly with black, grey and white, white areas with numerous minute brown spots.—Mexico on *Quercus engelmanni*. ----- *grandis* Kkll.
    - dd. Body subglobular, 7 mm. in diameter; marked with five transverse black bands composed of large round dots and fine lines, pebbled and marbled with black dots and specks between lines and dots, entire surface covered with minute black specks.—California on *Quercus*. ----- *mirabilis* King.
- bb. Insects of smaller size, 3 to 6 mm. in diameter.
  - c. Body convex without median longitudinal constriction.
    - d. Body strongly convex, 5 mm. in diameter and 5 mm. high, distinctly pyriform; surface shining, with three to five dark lines, color light brown with three to four dark brown bands of variable length and suffused dark brown, blotchy spots and round dots.—Massachusetts, Ohio, Indiana, Georgia on *Quercus*. ----- *andrei* King.
  - dd. Body globular or nearly so, never pyriform or conical.
    - e. Body variously marked, but not with light or dark bands.
      - f. Body strongly elevated, 5 to 6 mm. high.
        - g. Body dark, dirty gray, turning to nearly clear white in old weathered specimens, with black spots and minute black specks; 6 mm. high and 6 mm. long.—East of Rocky Mountains on *Quercus*.-----  
*galliformis* Riley.
        - gg. Body dark, irregularly marbled with white and black and reddish or black and reddish, minute

- points on white intensely black.—Oklahoma on *Quercus alba*. ----- *boguei* Ckll.
- ff. Body not so strongly elevated, 3.5 mm. high; light ochreous, marked with slightly darker redder tint, marking wanting on mid-dorsal line, leaving pale band with transverse rows of black spots, surface closely beset with minute dark dots.—Massachusetts, Delaware on *Quercus rubra*. ----- *kingii* Ckll
- ee. Body always marked with light or dark bands.
- f. Body marked with transverse lighter stripes.
- g. Body light brown, with several white stripes running parallel with segments, more or less pitted, pits dark brown or black; 4.5 mm. broad and 4 mm. long and 4 mm. high.—California on *Quercus oblongifolius*. ----- *austini* Ehrh.
- gg. Body light brown, generally with four transverse parallel white stripes, stripes with numerous brown dots; 5 to 6 mm. in diameter.—California on *Quercus chrysolepsis*. ----- *rattani* Ehrh.
- ff. Body marked with dark transverse stripes.
- g. Body with four dark transverse stripes.
- h. Body grayish white, distinctly marbled with light yellow or reddish brown, with four prominent linear transverse dark brown bands, somewhat wavy, due to quite large pits, surface speckled with minute black dots; 3 to 5 mm. broad.—Arizona on *Quercus*.----- *arizonensis* King.
- hh. Body yellowish brown, with four transverse very dark brown bands on meson, marbled with darker brown, some of marbling circular, surface marked with some dark brown spots; 5 mm. in diameter. —Connecticut on *Quercus*.----- *waldeni* King.
- gg. Body with five transverse narrow blackish bands, broken at intervals by somewhat larger round black dots, surface marbled light gray-brown between bands and covered with minute black specks.—California on *Quercus*. ----- *occidentalis* King.
- cc. Body with more or less distinct median longitudinal constriction or furrow.
- d. Body strongly gibbous or with humps.
- e. Body light brown without conspicuous black specks, dorsum usually marked with black lines and spots; 5 mm. long and 4 mm. broad and 4 mm. high.—California on *Quercus lobata*. ----- *cockerelli* Ehrh.
- ee. Body light brown with four transverse bands of light cream color, constriction not pallid, surface peppered with minute black specks; 6 mm. in diameter and 5 mm. high. —California on *Quercus agrifolia*.----- *essigi* King.

- dd. Body not gibbous or humped.
  - e. Surface of body not speckled with black, color lively ochreous, with bands and spots of dark brown and black, hind part with numerous pits.—Kansas on *Quercus macrocarpa*. ----- *concinulus* Ckll.
  - ee. Surface of body speckled.
    - f. Body with definite specks and other coloring but not arranged in transverse rows.
      - g. Body not globular, somewhat transverse, median furrow forming rather broad black or dark brown band, generally crossed by narrow blackish or brownish transverse lines of various length, between lines several black specks as large as pin heads, entire surface covered with minute black specks, color white marbled with gray, turning to nearly white, light lemon yellow in museum specimens.—Massachusetts on *Quercus rubra*.----- *sassceri* King.
      - gg. Body globular, not very pale ochreous, speckled all over with minute black specks, with more or less pallid transverse bands, median constriction obscure: 4.5 mm. long and 5.5 mm. broad and 4 mm. high.—California on *Quercus*.----- *nigropunctatus* Ehrh.
    - ff. Body with specks and other coloring arranged in transverse rows.
      - g. Body small, 4 mm. long and 4 mm. broad and 3.5 mm. high; french yellow in color with black spots and obscure black specks; median constriction marked by dark line, with distinct rows of black spots.—New York, Indiana, Massachusetts, Canada, Ohio on *Quercus alba* and *Quercus rubra*.----- *pettiti* Ehrh.
    - gg. Body large, at least 5 mm. long and 6 mm. broad.
      - h. Body varying in color from bright argillaceous to dull gray, more or less conspicuously speckled with black with bands of dark spots; median constriction crossed more or less by dark lines, a rounded dark spot on each side of front and elongated blotch a short distance above and below anal opening; 5.5 mm. long and 6 mm. broad and 4.5 mm. high.—East Rocky Mountains on *Quercus nigra*. ----- *trinotatus* Bogue.
      - hh. Body varying from light cream color to nearly white, often with bluish cast, with four broad transverse bands of light yellowish brown, surface thickly covered with minute black specks; median constriction very distinct on caudal portion; 5 mm. long and 6 mm. wide and 5 mm. high.—California on *Quercus chrysolepsis*.----- *branagani* King.

## CHAPTER XVIII

### SUBFAMILY APIOMORPHINAE

#### *The Pegtop Coccids*

The body of the adult female is turbinate or shaped like a peg-top, rarely like a spherical top, usually three or four times as long as broad, only rarely broader than long. The lateral margins are usually convex and are not margined. The segmentation of the body is usually distinct. The caudal end of the body is not inflated and the cephalic and lateral margins are not provided with a keel. The antennae are rudimentary, consist of three to five inconspicuous segments or are wanting. They are articulated to the ventral aspect of the head, distant from each lateral margin and near to each other. The eyes are inconspicuous. There is apparently an ocellana located on each lateral margin. The mouth-parts, rostrum and rostralis, are present. The rostrum consists of two segments. The legs, when present, are greatly reduced in size and rudimentary, the prothoracic legs are the smallest and the metathoracic the largest. The coxae may be greatly swollen, the femora enlarged, and the trochanters and claws may be wanting so that the leg consists of only three segments. The profemora are never greatly enlarged and the prothoracic legs are never fitted for digging. The trochantro-femoral and tibio-tarsal sutures are present or obsolete. The thoracic and abdominal spiracles are not definitely described and are not figured. The mesothoracic spiracles are never located near the anus. The stigmatic clefts, spinae, and canellae are wanting. The abdomen is variable in form and length, longer than the head and thorax combined in some species, shorter in others, or reduced to a mere projection in a few. It is usually convex on the dorsal and ventral aspects, never depressed. The lateral margins are convex and are never margined. All the segments are fully exposed and similar in appearance with distinct coriae between them, none are retracted to form a marsupium. The abdomen is never provided with an anal cleft and opercula or an anal ring and anal ring setae. The anal lobes are long and prominent, frequently strongly chitinized, but distinct anal setae are wanting. The caudal abdominal segment is long and distinct and not short and narrow and extending beyond the other segments. The body is provided with cerores, none of which are octacerores or pilacerores, and is never provided with ceratubae. The body is never enclosed in a resinous cell with three adjacent openings or covered by a scale with or without exuviae. Insects always live in galls and body is covered with mealy or powdered wax. The rectum is never provided with a long glassy tube of wax or with a chitinized rectal tube bearing rings of anacerores. The body is never naked and gall-like in form.



The female nymphs of all stages are provided with a rostrum and rostralis. The three pairs of legs are present in the first nymphal stage and in at least certain species in the second. The legs of the first nymphal stage are similar in form, those of the second are not, the prothoracic legs are smallest and the metathoracic are the largest, the prothoracic and mesothoracic are much farther apart than the mesothoracic and metathoracic. The profemora are never greatly enlarged and the prothoracic legs are never fitted for digging. The body is never provided with an anal cleft and opercula, octacerores, pilacerores, or ceratubae. The anal ring is distinct and bears six anal ring setae. The anal lobes are inconspicuous in the first nymphal stage, but the anal setae are large and prominent. The anal lobes are prominent projections in the second nymphal stage and the anal setae are small. The body is depressed or subdepressed, elliptical or oval in outline, and completely margined with fiabellate scales. The caudal end of the rectum is not strongly chitinized, forming a rectal tube with one or more rings of anacerores excreting a long glassy tube of wax.

The male apparently has four ocellanae, two dorsal and two ventral. The abdomen is not provided with long lateral filaments or with tufts of long wax filaments, but is provided with two white filaments at the caudal end, which are probably formed of wax. The stylus is stout.

The insects of this subfamily all produce galls. The species are confined to Australia and New Zealand. The great majority make their galls on different species of *Eucalyptus*, less than one per cent produce galls on plants of other species. Both sexes form galls and, what is very unusual, the galls formed by each sex is different in size and shape. As a rule the males make their galls on the leaves and the females on the stems and branches, although there are some exceptions to this. The galls are apparently in every species abnormal growths produced from the cambium layer of the plant and not through modification of the buds. The insects evidently attach themselves to the surface of the leaves or stems where they normally produce their galls. This effects in some way the cells of the plant and an abnormal growth begins which surrounds and eventually covers them, forming the mature gall. Whether the galls are due to irritation produced by the mouth-parts or from excretions from the salivary glands, Malpighian tubules, rectal glands, or some other internal structure is not known.

The galls produced by the females of the different species show a great variety of forms, varying in size from one-half to seven or eight inches in length and in some species may be as much as three inches in diameter although most are much smaller. Some resemble conical fruits, others nuts and globular fruits. While all the galls of a species are fairly constant, there is variation

in size and form and in the case of certain species, as with all gall forming groups, there is some variation between the individuals of the same species. The difference in the form of the various galls serves as one of the easiest methods of identifying the different species.

The galls of the males are short cylindrical tubes. Some are simple tubes with a notched rim at the free end or with the rim dilated forming a saucer-like tip. While the male galls are generally attached to the leaves, in a few species they are attached to the gall of the female.

The nymphs of the first stage are quite similar in appearance. They are bright or pale red or yellow in color. The body is flat or depressed, and elliptical or broad oval or almost round in outline. The legs are long and well developed in *Apiomorpha*, normal in form, bear several setae and a pair of digitules. In *Opisthoscelis* the prothoracic legs are wanting and the mesothoracic legs are rudimentary and the metathoracic legs are long and distinct. The antennae are slender and consist of three to seven segments. The single ocellana on each side of the head is large and prominent, and brownish red in color. The periphery of the body is distinctly margined or fringed with minute alate setae or scales, similar in size to the marginal scales of certain lecaniids, but differing from them in form in that their distal ends are truncate. Fuller describes the scales as stout alate spines, the wings of which are thin and transparent and soon broken. This would suggest that the wings might be wax excreted from marginal cerores supported by a seta as a central matrix. The scales are apparently limited to the head in *Opisthoscelis*. Froggatt in describing the nymphs of *Ascelis* and *Opisthoscelis* states that their tarsi are each provided with two claws, which is a very unusual number for the members of this family, and is evidently an error. The first stage nymphs are provided with an anal ring with anal ring setae, but the number of anal ring setae is not stated, it is probably six. The male nymphs differ from the female nymphs according to Froggatt only in being more elongate.

The female apiomorphids molt twice. The nymphs of the second stage are very different in appearance from those of the first. The body is broadest through the mesothorax, the two lateral margins converge cephalad and caudad from this region. The segmentation is distinct, but the margins have lost their marginal rim and their fringe of flattened scales. The antennae

are greatly reduced in size and the ocellanae are apparently wanting. The legs are also reduced, the prothoracic pair is directed cephalad and the others are directed caudad. The distance between the first and second pairs is much greater than that between the second and third. The abdomen tapers and the caudal segment is long and deeply cleft, the portion on each side of the cleft forms a stout, divergent, sharply pointed projection bearing several setae. Each of these projections is a modified anal lobe. The cephalic part of the ventral aspect bears a distinct anal ring with six anal ring setae. The surface of the body is covered with mealy wax.

The body of the adult female has been generally compared by the writers on the Apimorphinae, so far as their shape is concerned, to a peg-top. It is yellow or brownish in color with a distinct segmentation, the distinctness of which is emphasized by the constrictions between the segments. The head and prothorax, as is usual with coccids, are poorly separated and form a large cephalic region bearing the mouth-parts, the antennae, and the prothoracic legs when these are present. There is a deep transverse furrow on the ventral aspect separating the mesothorax and metathorax, from which there extends on the meson a broad furrow connecting with the curving furrow between the prothorax and mesothorax. This latter has been called the facial furrow by Fuller. The furrows produce a chin-like elevation upon which the mouth-parts are situated. There is considerable variation in the width of the mesothorax, which is usually the widest segment of the body. There is a corresponding variation in the shape of the facial furrow and its surrounding parts. The antennae and legs, even when present, are greatly reduced and the antennae sometimes consist of only three segments. Fuller states that the thoracic spiracles are distinct in the adult females of *Ascelis* and *Cystococcus*. The abdomen is conical and the three or four caudal segments are strongly chitinized. It is usually as long as the head and thorax together but in *Cystococcus* the abdomen is a mere tubercle. The anal ring and anal ring setae are apparently wanting in the adult female. The caudal margin of each of the abdominal segments is usually fringed with a transverse row of conical spine-like projections, this appears to be always true in Apimorpha. These projections are probably used by the insect in moving about in its cell in the gall. The caudal end of the abdomen bears two long slender anal lobes in Apimorpha and in

some species of *Opisthoscelis*, but are wanting in *Ascelis*. It is the presence of these lobes that gives the caudal end of the body of the insect a cleft appearance. It is claimed by Schrader that the anal lobes are used to keep the orifice in the gall open. This orifice is in the free end of the gall. While the anal lobes bear numerous setae, none of them can be identified as the anal setae. The body bears long slender setae, conical setae, and cerores. From these latter there is excreted powdery or mealy wax which completely coats the body of the insect.

The galls formed by the males have already been described. The males as they are figured by Froggatt resemble miniature two-winged ant-lions. The wings as represented are much broader than in the case of other male coccids. The abdomen is long, slender, and cylindrical and bears two long thread-like filaments at the caudal end which are twice as long as the entire body and are probably formed of wax. The antennae are long, setaceous, and consist of about ten segments. Froggatt states that, "when full grown the males emerge from the neighboring galls, and by means of their slender, pointed abdomen impregnate the imprisoned female through the apical orifice, through which the latter can exert her anal appendages. After impregnation the males die, and the females become a mass of eggs, from which the young larvae soon emerge, crawling through the opening in the gall and leaving the empty shell of the mother behind in the gall."

The writers upon the apiomorphids have not given any synopsis of the species, but have contented themselves with describing the galls, the adults, and certain of the nymphal stages. Froggatt makes the following comment as to the females: "To a casual observer the female coccids would appear very much alike but though there is a very strong resemblance in most cases, there are besides the difference in form, several very good specific peculiarities; firstly, in the form, shape, and situation of the anal appendages; secondly, in the hairy coating on the abdominal segments; and thirdly, in the number, shape, and regularity of the distribution of the tubercles and fine-toothed spines covering the upper side of the abdominal segments."

The four genera of Apiomorphinae can be distinguished by means of the following table:—

## GENERA OF APIOMORPHINAE

- a. Adult female with at least one pair of legs.
  - b. Adult female with three pairs of legs and rudimentary antennae of three to five segments; abdomen elongate, longer than head and thorax together, distinctly segmented; body tapering or pear-shaped. -----*Apiomorpha* Rubs.
  - bb. Adult female with prothoracic legs wanting, mesothoracic vestigial, and metathoracic legs very long and slender; antennae present and vestigial, consisting of three to four segments or wanting. -----*Opisthoscelis* Schrader.
- aa. Adult female without legs or antennae; abdomen very short, much shorter than either head or thorax, segmentation obsolete, head and thorax globular, abdomen appearing as tubercle upon one side of globule.
  - b. Body not longitudinally striate, globular but not with cephalic end truncate; spiracles present. -----*Ascelis* Schrader.
  - bb. Body longitudinally striate, globular with cephalic end truncate; thoracic spiracles large. -----*Cystococcus* Fuller.

**Apiomorpha Rubs.**—This name was proposed by Rübsamen for the genus *Brachyscelis* Schrader, which was preoccupied. By far the larger number of species of the subfamily belong to this genus. There are thirty species listed by Mrs. Fernald.

**Opisthoscelis Schrader.**—A genus of twelve species, all of which produce galls upon *Eucalyptus*.

**Ascelis Schrader.**—The adult females of this genus are greatly modified. There are four species described.

**Cystococcus Fuller.**—This genus was erected by Fuller to include his species *echiniformis* which forms a spherical gall from three-fourths to one inch in diameter. There is some question as to whether this genus can be distinguished from *Ascelis*. The walls of the gall are thin and uniform in thickness. The body of the female nearly fills the cavity in the gall. These galls according to Fuller are not only edible but are considered as a great delicacy by all the natives and all whites who know of them. The galls are broken between the teeth and the insect sucked out. They are considered as cool and refreshing on a hot day. Unless better characters are discovered than have been noted, the genus *Cystococcus* will fall as a synonym of *Ascelis* which has the thorax globular and the abdomen a mere protuberance on one side.

## CHAPTER XIX

### SUBFAMILY CYLINDROCOCCINAE

#### *The Lubberly Coccids*

The body of the adult female is variable in form, circular and thickened, spherical or globular, or cylindrical and elongate. The lateral margins are broadly convex or subvertical, rarely if ever sharply margined. The cephalic and caudal ends are broadly rounded, sometimes continuous with the lateral margins, so that the outline of the body is almost a complete circle, or truncate. The segmentation may be distinct, obscure, or wanting, rarely sharply defined. The caudal end of the body is not inflated and the cephalic and lateral margins are not provided with a keel. The antennae are variable in form, when present, consist of less than seven segments, frequently rudimentary, mere tubercles, or wanting. They are articulated to the cephalic part of the ventral part of the head. The eyes are apparently wanting. The mouthparts, rostrum and rostralis, are always present, the rostrum consists of two segments. The legs are present or wanting, when present, they may be subequal in size and similar or may have one pair much longer than the other two pairs or they may all be tuberculate. The profemora are never enlarged and the prothoracic legs are never fitted for digging. The trochantro-femoral and the tibio-tarsal sutures of all normally formed legs are always distinct. The spiracles of the mesothorax and metathorax are large and prominent, and ventral in position. The mesothoracic spiracles are never located near the anus. The abdominal spiracles are always wanting. The stigmatic clefts, spinae, and canellae are wanting. The abdomen is variable in length, about as long as the head and thorax together or longer or not as long as the metathorax alone, never depressed, but may be thick and flattened. The lateral margins are uniformly convex without a margin and the caudal end may be rounded or truncate. All the segments are fully exposed and subsimilar in appearance, none are retracted to form a marsupium. The abdomen is never provided with an anal cleft and opercula, an anal ring and anal ring setae, or anal lobes and anal setae. The caudal abdominal segment, if short and narrow, is never protruding. The body is provided with ceros none of which are octacerores or pilacerores and is never provided with ceratubae. The body is never enclosed in a resinous cell with three adjacent openings or covered by a scale with or without exuviae. The insects either live in galls or live free. The body may be wholly or in part covered by a compact mass of wax with mealy or powdery wax. The rectum is never provided with a long glassy tube of wax or with a chitinated rectal tube with rings of anacerores. The body is never naked and gall-like in form.

The female nymphs of all stages are provided with a rostrum and a rostralis. The three pairs of legs are present in the first nymphal stage and in the second nymphal stage so far as known and are similar or subsimilar in form. The profemora are never greatly enlarged and the prothoracic legs are never fitted for digging. The body is never provided with an anal cleft and opercula, an anal ring and anal ring setae, octacerores, pilacerores, or ceratubae. The anal lobes are generally small, but even if not prominent, frequently with prominent anal setae in the first nymphal stage. The caudal end of the rectum is not strongly chitinized, forming a rectal tube with one or more rings of anacerores excreting a long glassy tube of wax. The caudal abdominal segment is not short, narrow, and projecting.

The male has ocellanae. The abdomen is not provided with lateral filaments or with tufts of long slender glassy threads of wax, but with two long white caudal filaments. The wings are present. The stylus is about as long as broad.

The subdivision Idioccocidae was proposed in 1893 by Maskell to include two genera, *Cylindrococcus* and *Sphaerococcus*, which he had described. The group was defined to include the following: "Adult females active or stationary; gall-making, or naked, or producing cotton or wax. Anal tubercles entirely absent. Anal ring hairless. Antennae with usually less than seven joints. Body not prolonged posteriorly." When this group was erected, the first genus contained two species and the second genus five. In Fernald's Catalogue the first of these genera, *Cylindrococcus*, contains four species and the other, *Sphaerococcus*, nineteen. Maskell in 1895 in a list of the Australian coccids gives the Idioccocidae as a section of the subfamily Coccinae, the Eriococcinae of this work, and associates it with the genera included in the Eriococcinae as given on preceeding pages. Cockerell in his "Check-list" published in 1896 adopts Maskell's name and recognized it as a group, but combined it with the Eriococcinae in 1899. Green in the first volume of his Coccidae of Ceylon also adopts Maskell's name and characterization with this addition: "Larvae with anal tubercles, adult without." The term Idioccocidae is not tenable or usable as a group name, as a subfamily or family name, because it is not based upon a generic name. For this reason the subfamily name *Cylindrococcinae* has been used for this group.

At the time when Maskell characterized his Idioccocidae, the tendency was to rely upon the characters of the adult female alone and not to use, at least to any extent, the characters of the nymphs. Several of the genera now placed in the Eriococcinae, would according to Maskell's definition, fall into the *Cylindrococcinae*, since their adult females do not have an anal ring or anal ring

setae. These structures are present, however, in the first nymphal stage and frequently in the other nymphal stages of the female. Maskell figures for the second nymphal stage of the female of the type species, *casuarinae* Maskell, of the genus *Sphaerococcus*, an anal ring with two anal ring setae. This genus for this reason should be removed to the subfamily Eriococcinae. It does not follow that the remaining eighteen species of this genus are eriococcids. Two of these have already been removed as the types of new genera, one being referred to the Eriococcinae and the other to the Asterolecaniinae. Several of the other species represent another generic type, particularly the species forming galls from the buds of plants.

The females of the generalized Anal Ring Conservers have a well developed anal ring with anal ring setae, not only in the adult, but in all nymphal stages of the female. Associated with the anal ring is the presence of anal lobes and anal setae. The anal lobes, when the abdomen is swollen with eggs, become inconspicuous. One of the lines of specialization in the eriococcids is the gradual suppression of the anal lobes in the adult female followed by an obsolescence of the anal setae. These structures are both very prominent in the second nymphal stage of the generalized genera, but with specialization are crowded out of this stage into the first nymphal stage. The anal ring and the anal ring setae pass through a similar series of stages of obsolescence. First there is a reduction in the size of the anal ring setae in the adult female followed by a reduction in the number until they are all wanting and the adult female lacks not only the anal ring but the anal ring setae. The second nymphal stage passes through a similar series of changes and reductions. This results in the inclusion in the subfamily Eriococcinae of all those genera whose species are provided with at least some anal ring setae in the first nymphal stage.

There is considerable question as to whether the Cylindrococcinae are a natural group or not. Their structure would suggest that they were highly specialized eriococcids that had gone one step farther. That is they lack an anal ring and anal ring setae not only in the adult female and its second nymphal stage, but also in the first nymphal stage. They usually lack anal lobes and anal setae in all stages or, if present, are greatly reduced in size. If this interpretation is correct, the Cylindrococcinae is not a natural subdivision but simply the highly specialized end of the Eriococcinae that has lost through specialization by reduction the charac-



ters used in separating this group from the *Cylindrococcinae*. The following quotation would suggest that Maskell held a similar view. "Moreover, I propose to characterize the *Idiococcidae* by such wide and comprehensive features as will permit the future inclusion therein of other genera which may hereafter be discovered; in fact, I mean, the subdivision to serve as a receptacle for, perhaps many insects which cannot possibly enter into the others, and so we may avoid, so far as possible, multiplication of names."

The species of one genus of this subfamily form galls upon plants. A considerable number of these are from the Australian region. While the galls of the *Apiomorphinae* are formed upon the tissue of the stems and leaves of the plants, those of the gall making species of the *Cylindrococcinae* are in most cases modifications of the buds. The galls resulting from such parts of the plant, are, as in most of the galls formed in similar situations by other insects, miniature cones. The species of a few genera live in blister-like swellings upon the bark or leaves. These swellings are abnormal growths upon the plant and should probably be considered as galls. The galls made by the species of *Cylindrococcus* are usually comparatively small, never so voluminous as in the female galls of many *apiomorphids*.

The adult females of a number of the species are enclosed in a test of wax which completely encloses them and frequently has an opening at one end or on one side. The wax of the test, when a definite one is formed, is not voluminous, but is hard and not easily soluble in caustic potash. The test in two genera is shaped like a Grecian lamp. In the case of *Ourococcus* the insect lives in a crevice in the bark, excretes a black covering of wax and a long glassy tail of wax. The three species of *Capulina* are suggestive of the conditions found in this subfamily. The body of the adult female of *sallei*, the type, is covered with a white cottony sac of wax with a single long caudal tube of wax, *jaboticabae* makes neither gall nor definite sac and desposits her eggs in a fluffy mass of white cottony wax, while *crateriformis* makes a small crater-shaped gall or depression.

There is great variation in the external shape of the adult female. The body may be elongate with parallel sides, cylindrical or subcylindrical in form, or may be orbicular in outline, like a thickened pancake with the peripheral margin convex. The mouthparts, including the rostralis and rostrum, are always present. The head and prothorax form a single region in the gall forming

species and this region is distinctly separated from the mesothorax. The segmentation of the thorax and abdomen is usually distinct in these species, but in the wax forming species it is generally completely effaced, frequently indicated only by the marginal setae. In many coccids there is a definite number of setae or cerores or groups of cerores along each lateral half of the body. This is illustrated by the *cerari* found in many eriococcids. The number of setae or cerores varies somewhat with the species, usually the number is about eighteen, of which the first four of each side belong to the head, two to each thoracic segment, and one to each abdominal segment. The number may be slightly increased or decreased, or the number may be doubled, twenty-eight on each side. While the antennae and legs and all indication of the intersegmental coriae may be wanting, the extent of the various segments of the body can be closely approximated by a study of the number and arrangement of the marginal setae or other marginal structures that may be present.

The antennae of the adult female, even when present, is greatly reduced and consists of only a few segments, always less than seven, according to Maskell. The legs like the antennae are greatly modified. They are frequently wanting and when all are present, one pair is much larger than the others. The thoracic spiracles although not described or figured for all the species are undoubtedly present and located on the ventral aspect. The abdomen is elongate in the gall forming species but is very short in some of the species that are covered with wax. Abdominal spiracles are not recorded as present in any of the species and the anal ring and anal ring setae are also wanting.

The nymphs of the first stage, where known, are elongate, ovate in outline and resemble very much the first stage nymphs of the eriococcids. The segmentation is indicated, the ocellanae are present, the antennae are long and slender and consist of six segments, and the legs are long and typical in form. The caudal end of the body may bear anal lobes, which are distinct or may be wanting. The anal setae are also frequently present. The dorsal aspect of the body may bear six longitudinal rows of setae, known as dorsal setae, or transverse rows of ten setae each or the setae may be very small and not arranged in rows or they may be wanting. The anal ring so far as indicated is always wanting. It needs more careful study than has been given it thus far in this group.

The males in the wax forming species excrete an elongate white sack of loose cottony filaments of wax or a small cylindrical horny ferruginous sac of wax in which transformation takes place. The males of three genera have been described, *Capulina*, *Carpochloroides*, and *Halimicoccus*. The descriptions are incomplete, but there is nothing to suggest that they differ from the males of the associated subfamilies. The genera referred to the subfamily *Cylindrococcinae* can be separated by means of the following table:—

GENERA OF CYLINDROCOCCINAE

- a. Thorax of adult female with at least one pair of complete legs present.
  - b. Thorax of adult female with three pairs of legs, prothoracic and mesothoracic pairs small and rudimentary, metathoracic pair large and prominent; nymphs of first stage without rows of dorsal conical setae. ----- *Sphaerococcopsis* Ckll.
  - bb. Thorax of adult female with only single pair of legs present; nymphs of first stage with rows of dorsal conical setae.
  - c. Thorax of adult female with metathoracic legs present and prothoracic and mesothoracic legs wanting; nymphs of first stage with two complete rows of dorsal setae; females either not forming galls or living in crater-like depressions.----- *Capulina* Sign.
  - cc. Thorax of adult female with prothoracic legs present and mesothoracic and metathoracic legs wanting; nymphs of first stage with four rows of dorsal setae; females forming galls on plants. ----- *Cylindrococcus* Mask.
- aa. Thorax of the adult female with all three pairs of legs wanting.
  - b. Abdomen of adult female emarginate at caudal end with a pair of anal lobe-like projections, anus located at bottom of emargination from which projects long glassy tube of wax.--- *Ourococcus* Fuller.
  - bb. Abdomen of adult female not emarginate at caudal end and not with anal lobe-like projections.
  - c. Nymphs of first stage with dorsal longitudinal rows of conical setae.
  - d. Antennae of adult female tuberculate, bearing terminal bunch of stiff setae; anal tubercles wanting but indicated by groups of conical setae; body with numerous setae near anus. ----- *Apiococcus* Hempel.
  - dd. Antennae of adult female wanting; anal tubercles wanting and not indicated by groups of setae; body not with numerous setae near anus.----- *Carpochloroides* Ckll.
  - cc. Nymphs of first stage not with dorsal longitudinal rows of conical setae.
  - d. Body enclosed in horny sack of wax shaped like lampshell; cuticle of adult female not tuberculate and without conspicuous cerores; antennae and legs wanting.--- *Halimicoccus* Ckll.

- dd. Body not enclosed in horny sack of wax; cuticle of adult female with numerous hyaline tubercles without conspicuous cerores and without setae; antennae tuberculate and legs wanting. -----*Phoenicococcus* Ckll.

**Sphaerococopsis** Ckll.—This genus includes a single species, *inflatus* Maskell from Australia on Eucalyptus. It is somewhat similar in general appearance to *Pseudoripersia turgipes* Maskell, but the adult female lacks an anal ring and anal ring setae. The legs are also different in size and form.

**Capulinia** Sign.—The three species referred to this genus are: *crateraformis* Hempel from Brazil on Eugenia; *jaboticabae* von Ihering from Brazil on Eugenia and Myrciaria; and *sallei* Signoret, the type, from Mexico on "Capulino" and "Escobillo".

**Cylindrococcus** Mask.—An Australian genus of four species occurring upon Casuarinia: *amplior* Mask., *casuarinae* Mask., *gracilis* Fuller, and *spiniferus* Mask.

**Ourococcus** Fuller.—A genus from West Australia found upon Eucalyptus and Casuarinia. The species are: *casuarinae* Fuller, *cobbii* Fuller, and *eucalypti* Fuller. The immature stages are unknown. The anal ring and anal ring setae are not described. The form of the caudal end of the abdomen and the fact that in each species a caudal glassy tube of wax is formed suggests that the anal ring and anal ring setae are present and that this genus should be placed in the subfamily Eriococcinae, falling in the table of genera near *Antonia*, or if without an anal ring the rectum must be provided with rings of anacerores.

**Apiococcus** Hempel.—A Brazilian genus found upon Myrtaceae. It contains the four following species: *asperatus* Hemp., *globosus* Hemp., *gregarius* Hemp., and *singularis* Hemp.

**Carpochloroides** Ckll.—This genus contains a single species, *viridis* Ckll., which is found upon Eugenia and Myrtaceae in Brazil.

**Halimococcus** Ckll.—A single species, *lampas* Ckll., occurring upon the leaves of palm in Natal. The abdomen is provided with four long setae at the caudal end instead of two as in *Phoenicococcus*.

**Phoenicococcus** Ckll.—There is a single species, *marlatti* Ckll., which occurs upon date palm in Algeria. It has been identified on date palm received at quarantine from Algeria.

## CHAPTER XX

### SUBFAMILY CONCHASPINAE

#### *The Exuvialless Scales*

The body of the adult female is depressed, broadest across the prothorax. The lateral margins gradually converge caudad, they are thin and convex but not margined. The segments are well defined. The caudal end of the body is not inflated and the cephalic and lateral margins are not provided with a keel. The antennae are prominent, consist of three segments, and are articulated to the ventral aspect of the head near each lateral margin. The eyes are present. There are two ocellanae located on the dorsal aspect, nearer to the meson than to the lateral margin of the head. The mouth-parts, the rostrum and rostralis, are present, the rostrum consists of two segments. The legs are present. They are subequal in length and normal in form. The profemora are never enlarged and the prothoracic legs are never fitted for digging. The trochantal-femoral sutures are present and the tibio-tarsal sutures are wanting. The spiracles of the mesothorax and metathorax are normal in size and ventral in position. The mesothoracic spiracles are never located near the anus. The abdominal spiracles are limited to a single pair located on the ventral aspect of the first segment, their spiracular tracheae are never provided with rings of cerores. The stigmatic clefts, spinae, and canellae are wanting. The abdomen is about as long as the head and thorax together, and is convex on the dorsal and ventral aspects, always more or less depressed. The lateral aspects are convex but distinct, not distinctly margined, the caudal end is convex. All the segments are fully exposed and subsimilar in appearance with distinct coriae between them, none are retracted to form a marsupium. The abdomen is never provided with an anal cleft and opercula, or anal lobes and anal setae. An anal ring and anal ring setae may be present. The caudal abdominal segment is never short and narrow and extending beyond the other segments. The body is provided with cerores none of which are octocerores or pilacerores and is never provided with ceratubae. The body is never enclosed in a resinous cell with three adjacent openings, but is always covered by a scale which does not contain exuviae. The rectum is never provided with a long glassy tube of wax or with a chitinated rectal tube with rings of anacerores. The body is never naked and gall-like in form.

The female nymphs of all stages are provided with a rostrum and rostralis. The three pairs of legs are present in all nymphal stages and are similar in form. The profemora are never greatly enlarged and the prothoracic legs are never fitted for digging. The body is never provided with an anal cleft and opercula, anal lobes and anal setae, octa-

cerores, pilacerores, or ceratubae. An anal ring and anal ring setae may be present. The caudal end of the rectum is not strongly chitinized forming a rectal tube provided with one or more rings of anacerores excreting a long glassy tube of wax. The caudal abdominal segment is not short, narrow, and projecting.

The male has four ocellanae, two dorsal and two ventral. The abdomen is not provided with long lateral filaments or tufts of long wax filaments or with two long thread-like filaments. The stylus is long, one-half or more the length of the body.

This subfamily contains three genera, *Conchaspis* of Cockerell, *Fagisuga* of Lindinger, and *Scutare* of Brittin. The typical genus was based upon specimens collected in the West Indies. A description of them was published in February, 1893, under the name of *Conchaspis angraei*. In July of the same year Newstead described this same species as *Pseudinglisia rodrigueziae* from plants imported from Trinidad. Four other species of the typical genus are now known. The genera of Lindinger and Brittin each contain only a single species.

The scale of the adult female of *Conchaspis* is circular in outline, elevated at the center and bluntly conical. The surface of the scale is unmodified in *socialis* Green, while there are six to eight ridges radiating from the apex of the cone but not reaching the periphery of the scale in *angraei* Cockerell. The ventral scale is complete, free from the dorsal scale, and adheres to the host-plant. The dorsal or outer scale is opaque to grayish brown or black. The female scales resembles the convex light colored scales of certain diaspids, but they can always be separated from these scales, because in the Conchaspinae the molted skins or exuviae are never fixed in the dorsal or ventral scale. It is evident that the molted skins, which are probably not more than two, although the number is unknown in either sex, after they are shed, are pushed out under the margin of the scale as in the males of certain lecaniids.

The scale of the male is known only in *socialis* Green. It is described by Green as "white, oblong, flattened, closely felted, completely enveloping the pupa. The hinder extremity has a valvular opening. Length 1.50 mm. and breadth at widest part is about 0.75 mm. The male puparia do not occur separately, but are always collected together, in groups of ten or more, beneath the parent scale (that of the female) which they completely fill." It is questionable whether this is the true scale of the male and whether it is comparable to the scale of the female, but rather a cocoon. May it not be that the male does not form a scale.

The body of the adult female as viewed from above resembles somewhat in general appearance an eriococcid nymph of the first stage, but the segmentation is indicated more distinctly and the body is more depressed. The eyes are present, located on the dorsal aspect, near together and near the cephalic portion of the body. The antennae are small, consist of three or six segments, and are articulated to the ventral aspect of the head, distant from each other and from the rostrum, which consists of two segments. The legs are long and project beyond the lateral margin of the body, probably due in great part to their articulation to the sternum very distant from each other. They usually lack the suture between the tibia and tarsus. Each bears a few long setae, but lacks digitules. The claws are bluntly toothed on the ventral side at the proximal end. The mesothoracic spiracles are located near to and laterad of the prothoracic legs while the metathoracic spiracles are located a short distance caudad of the mesothoracic legs. A third pair of spiracles, those of the first abdominal segment, are located just caudad of the metathoracic legs. The caudal abdominal segments have chitinated areas which are considered by Newstead as similar to the pygidium of the diaspidids. These plates bear large circular cercores which are distributed over the segments or are arranged in groups as in *socialis* near each lateral margin of the ventral aspect of segments one to three. There is in this species on the lateral margin of segments one to four small groups of short broad tubular ducts which open on the dorsal surface. The lateral margin of each segment of the thorax and abdomen bears a group of three or four long slender setae. The abdomen does not contain ceratubae or oraceratubae, structures which are so characteristic of all diaspidids. The size of the body of the adult female is remarkable, as Green states, in *socialis* it is 1.25 mm. long and 0.80 mm. wide, while the scale has a diameter of 5 mm. The female deposits her eggs which are long and purplish in color under her scale where they are mixed with the cocoons of the male.

The adult male is known only in *socialis* Green. The body is yellowish in color. The head is rounded, bears four simple eyes or ocellanae, two dorsal and two ventral, and two antennae, each consisting of seven segments. The distal segment bears four knobbed setae and the other segments bear numerous small conical setae. The wings are large and held in place by prominent halteres. The caudal end of the abdomen bears a slender stylus that is more

than one-half the length of the body. Green was unable to follow the life history of the male, but found some nymphs in their cocoons that were oval in outline, still retained their nymphal legs, and bore antennae consisting of four segments.

Our knowledge of the development of the female is very limited. Newstead states that the nymphs of the first stage resemble the adult female except that they are smaller. They are short and ovate in outline and have antennae of six segments, of which the two distal segments are the longest. The legs lack the tibio-tarsal suture as in the adult female but differ in that there are two tibial and two ungual digitules present. The abdominal segments are also provided with plates. The three genera of this subfamily can be separated by means of the following table:—

#### GENERA OF CONCHIASPINAE

- a. Body of adult females not with broad multidenticulate projections; dorsum of caudal end of abdomen not with thickened plate-like projection on each side of meson; setae of lateral margin of each segment long, in groups or two or more.
  - b. Abdomen with caudal end projecting, not with anal lobes bearing setae; tergum of thorax with ventral aspect never with continuous marginal fringe of setae.-----*Conchaspis* Ckll.
  - bb. Abdomen with caudal end deeply hollowed out, hollow bounded on each side by a prominent anal lobe bearing one long slender seta and three short stout setae; tergum of thorax with continuous fringe of short setae.-----*Scutare* Brittin.
- aa. Body of adult female with three broad, multidenticulate, pectinae-like projections; dorsum of caudal end of abdomen with thickened plate-like projections on each side of meson; each plate with row of three short setae; lateral margins of segments apparently without setae; caudal end of abdomen truncate, bearing near margin six ventral and four dorsal setae.-----*Fagisuga* Lindinger.

*Conchaspis* Ckll.—This genus with its four described species is placed between the Phenacoleachiinae and Dactylopiinae by Mrs. Fernald in her Catalogue. Green and Newstead place it before or after the Diaspidinae, a more logical location it would seem. The species of this genus can be separated by means of the following table:—

#### SPECIES OF CONCHIASPIS

- a. Antennae of adult female with five or six segments, scale of adult female conical but not fluted.
  - b. Antennae of adult female with six segments, segments subequal in length; abdominal segments with four groups of cerores, larger number on cephalic segments, with scattered cerores between groups.—Mexico on Plumieria.-----*newsteadii* Ckll.
  - bb. Antennae of adult female with five segments, two distal seg-



ments obscure, segments variable in length, third twice as long as fifth, distal segment with two thick compressed setae on distal end, antennal formula 35142; abdomen broader than head and thorax, cephalic part of ventral aspect with two much compressed thick setae; caudal abdominal segments with glandular areas on dorsal and ventral aspects.—Brazil on a woody shrub...  
*fluminiensis* Hemp.

- aa. Antennae of adult female with less than five segments.
- b. Antennae of adult female with four segments; cerores found on all abdominal segments and generally distributed; scale of adult female fluted.
  - c. Body of adult female purplish red; scale conical with apex at center.—England, West Indies, United States, Mexico on *Angraecum*, *Rodriguezia*.....*angraccei* Ckll.
  - cc. Body of adult female colorless, except brown plates of abdomen; scale conical with apex on one side.—Mexico on *Hibiscus*.  
*angraccei hibisci* Ckll.
- bb. Antennae of adult female with three segments; cerores arranged in group on each side of abdominal segments one to three; scale of adult female not fluted.—Ceylon. ....*socialis* Green.

**Scutare Brittin.**—Scale of female is flat, subcircular, glassy, fringed, and ventral scale is complete. The adult female is widest through the thorax. The antennae consist of six segments and the rostrum of two segments. The thoracic spiracles are represented by two pairs. The legs are present and normal in form. The abdomen is distinctly segmented with distinct chitinized areas. The anal lobes are distinct, subtriangular. On each side of each abdominal tergum within the margin there are four short cylindrical setae, these are continued around the margin of the thorax. The tergum of the abdomen between the anal lobes and fifth segment is provided with a row of similar setae on each side of the meson. The anal ring located between the anal lobes, bears six long fine setae. Adult insect with covering scale does not resemble other species of subfamily. The presence of an anal ring with anal ring setae and a scale fringed with glassy threads of wax needs to be confirmed. A single species, *fimbriata* Brittin, is the type.

**Fagisuga Lindinger.**—A single species, *triloba* Lindg., is the type. It occurs in Chile on *Nothofagus*. The scale is about 1 mm. in diameter, without exuviae, conical, not fluted, dirty white in color. The body is 0.69 mm. long and distinctly segmented. The antennae consist of four segments. Its formula is 4312. The body on each side adjacent to the lateral margins of the denticulate projections is provided with several tooth-like projections.

## CHAPTER XXI

### SUBFAMILY DIASPIDINAE

#### *The Armored Scales*

The body of the adult female is variable in form, frequently slightly longer than broad, often distinctly broader than long, sometimes four or more times as long as broad, when comparatively short, broadest through the spiracular region, always more or less depressed. The lateral margins, at least of the caudal part, always thin and distinct and converging caudad. The caudal end of the body is not inflated and the cephalic and lateral margins are not provided with a keel. The antennae are usually wanting, sometimes each is represented by an unsegmented tubercle located on the ventral aspect, bearing one or more setae. The eyes are wanting. The mouth-parts, rostrum and rostralis, are always present, the rostrum consists of a single globular segment. The legs are always wanting. The spiracles of the mesothorax and metathorax are always present, normal in form and size, ventral in position. The mesothoracic spiracles are never located near the anus. The abdominal spiracles are always wanting. The stigmatic clefts, spinae, and canellae are wanting. The abdomen is rarely if ever longer than the head and thorax together, when the body is elongate, the elongation is confined for the most part to the thorax. The dorsal and ventral surfaces near together, particularly on the caudal half, where the body is distinctly depressed. The lateral margins sharply defined and convex. The caudal end is bluntly rounded, bluntly pointed, or rarely truncate. All the segments are fully exposed or at least no part is retracted to form a marsupium. The abdomen is never provided with an anal cleft and opercula, an anal ring and anal ring setae, or anal lobes and anal setae. The abdomen is divided into two regions, a cephalic segmented preabdomen and an unsegmented caudal pygidium upon which the caudal segment can not be identified. The body is provided with only a few cerores, limited, when present, to the spiracerores and the genacerores. The body is never provided with pilacerores or octacerores. The ceratubae are always present. The body is never enclosed in a resinous cell with three adjacent openings. It is always covered by a scale with one or two exuviae. The rectum is never provided with a chitinated rectal tube bearing rings of anacerores excreting a long glassy tube of wax. The body is never naked and gall-like in form.

The female nymphs of all stages are provided with a rostrum and a rostralis. The three pairs of legs are present in the first nymphal stage and wanting in all others, those of the first nymphal stage are normal in form and structure. The profemora are never greatly enlarged and the prothoracic legs are never fitted for digging. The body is never provided with an anal cleft and opercula, an anal ring and

anal ring setae, pilacerores, or octacerores. The anal lobes in the first nymphal stage are indicated with varying degrees of distinctness and the anal setae are rarely wanting. The ceratubae, although usually few in number, can generally be recognized. The caudal end of the rectum is not strongly chitinized with one or more rings of anacerores excreting a long glassy tube of wax. The caudal abdominal segment can not be identified.

The male has six ocellanae, two dorsal, two sublateral, and two ventral. The abdomen is not provided with long lateral filaments of wax or two thread-like caudal filaments of wax. The wings are sometimes wanting. The stylus is long and slender.

The eggs, in the case of those species laying eggs, are deposited under the scale behind the body of the female. They are elongate in form with the two ends rounded and are whitish, yellowish, or reddish in color. The surface of the eggs is frequently more or less dusted with fine granules of wax, excreted by the genacerores.

The young nymphs when they hatch remain for a time under the scale of the parent. All the eggs on the same branch or tree apparently hatch at about the same time and the young first stage nymphs swarm out from under the various scales, so that the smaller branches of the host-plant, where the infestation is heavy, are so densely covered with the young mite-like coccids that the branches appear grayish in color. The young insects after wandering about on the branch or branches for a few hours insert their rostralis and attach themselves to the host-plant and begin to draw nourishment.

The first stage nymphs, in which the males are indistinguishable from the females, are normally provided with antennae of six segments. The distal segment is long and constricted and appears as if composed of several fused segments. There is a single ocellana on each side near the articulation of an antenna. The rostrum, consisting of a single globular segment, and the rostralis are easily identified. The loop of the rostralis extends into a prominent crumena which projects into the cavity of the abdomen. The legs consist of the normal number of segments and are articulated near together distant from the lateral margin of the body. They are long enough, however, so that they project beyond the margin of the body. The tarsi usually bear two tarsal and two ungual digitules. The body, which is more or less depressed and oval in outline, has a fairly distinct segmentation of the thorax and abdomen. This latter, which apparently consists of six segments, is in reality composed of two parts, the cephalic five segments constitute the preabdomen and the apparent sixth segment,

which is formed by the fusion of four others, is known as the pygidium. The abdomen, therefore, consists of nine segments. The five preabdominal segments are distinct in *Lepidosaphes*, but in *Chionaspis* and some other genera, the fifth preabdominal segment is combined with the pygidium, so that in such genera there are apparently four segments in the preabdomen and five in the pygidium. The margin of the pygidium and of the abdominal segments usually bears projections, but they are quite different in form from those found in the adult and described later. The caudal portion on each side of the meson bears a large prominent seta, an anal seta, which is one-half or more the length of the body. The first stage nymphs of certain genera show structures that may be anal lobes, but they are never distinct. The anal ring and anal ring setae are never present. The anus, a circular opening located on the dorsal aspect of the pygidium, is always distinct.

The first nymphal stage is a comparatively short one. There is considerable variation among the different genera in the way in which the cuticle is molted at this time. In the genera *Diaspis*, *Lepidosaphes*, and their allies the old cuticle is ruptured transversely between the points of attachment of the antennae and the rostrum. The cuticle is then ruptured along each lateral margin to the pygidium and the ventral portion of the cast skin or exuvia is rolled caudad and comes to rest upon the pygidium. This explains why the mouth-parts are located over the pygidium in certain mounted individuals, a condition that nonpluses many beginners. This method of dividing the exuvia separates the antennae which remain attached to the cephalic portion of the dorsal exuvia and project horn-like beyond its cephalic margin, even in old dried exuviae, while the caudal portion of the ventral exuvia is folded upon the pygidium. In the genus *Aspidiotus* and its allies the split extends entirely around the margin of the body and the entire dorsal aspect is separated from the ventral, forming two distinct plates, a dorsal exuvia and a ventral exuvia. The dorsal plate in this case always lacks the dried porrect antennae. The dorsal exuvia forms a part of the dorsal scale and the ventral exuvia forms a part of the ventral scale, but is frequently lost.

The female nymphs at the first molt lose their antennae and legs, become greatly enlarged in size, and are more like the adult in general form. This is also true of the structures on the margin of the pygidium. The second stage females may live for a con-

siderable time, several months, the length of this stage varying greatly with the species. When the insects of this stage molt, there is no variation in the way in which the cuticle ruptures, but in all species there is a transverse rupture on the ventral aspect cephalad of the rostrum which connects on each side with the lateral margin, the further rupture of the cuticle extends caudad along each side to the pygidium. The ventral portion of the exuvia is rolled back upon the caudal portion of the ventral aspect of the body.

The females at the completion of the second nymphal stage and after the second molt assume the adult condition. The most striking variation found in the adult female from that of the second nymphal stage is the great increase in size and the greater complexity in the structure of the caudal portion of the abdomen.

The male of the second nymphal stage is similar to the same stage of the female. It lacks both legs and antennae, but possesses a rostrum and rostralis. At the second molt all similarity between the male and female is lost and the males of the third nymphal stage are elongated. The rostrum and rostralis are wanting and the developing legs and antennae have become of such size that they show externally, each enclosed in a cuticular sac. The male nymphs during this stage because of their similarity to the pupae of insects with a complete metamorphosis are often incorrectly designated as pupae and those of the second stage as propupae. The third nymphal stage requires only a few days for its completion and after the final or third molt the insect transforms to an adult.

The adult males, after completing their nymphal development, push the exuvia of the last molt out under the margin of the scale and the fully formed insect normally remains for several days under the scale. This is evidently for the further completion of the development of the adult organs. The wings are fully expanded during this time.

The completely formed male is very different in appearance from the adult female. The constrictions separating the segments of the body are distinct. The eyes are simple and six in number, four dorsal ocellanae, two of which are large and subequal in size to the two ventral ocellanae. The antennae are typical in form and consist normally of ten segments. The thorax is characteristic in form and bears the nine-segmented abdomen. The stylus is long and pointed, often one-half or more the length of the abdomen.

It is a valvular structure through which the flexible penis can be extruded. The wings, which are normally present and prominent, are sometimes wanting or greatly reduced in size in certain individuals.

The adult females vary greatly in form, size, and structure in the different genera. The body may be elongate oblong, two or three times as long as wide, linear, five or more times as long as wide, oval or circular, varying from slightly longer than broad to broader than long.

The constriction between the head and prothorax in the female is rarely if ever marked while those bounding the other thoracic segments may be distinct, obscure, or wanting. The antennae are at most represented only by unsegmented tubercles bearing a single large seta and in some species a few small setae. These tubercles are articulated to the cephalic part of the ventral aspect near to each other and to the meson. The ocellanae are always wanting in the second nymphal and adult female. The mouthparts are well developed. The rostrum consists of a single segment which is globular in form. The rostralis is long and forms a distinct rostral loop within the crumena except in individuals where the rostralis has been pulled out of the crumena in removing the specimen from the host-plant. The rostrum, rostralis, and crumena are always associated with a well developed endoskeleton.

The thoracic spiracles are always distinct and the spiracular trachea connecting with each is modified into a distinct hour-glass or trumpet-shaped cavaera. The mesothoracic spiracles are located on each side of the attachment of the rostrum, while the metathoracic spiracles are frequently located farther apart and about as far caudad as the two mesothoracic spiracles are distant from each other. This distance will vary slightly not only with the species but with the different individuals of the same species. When there are indentations in the lateral margin marking the constrictions between the thoracic segments, the spiracles are generally located in line with these constrictions. It is doubtful if these indentations represent the rudiments of the stigmal clefts and canellae, but in many species there are often a few spiracerorae associated with the spiracles, more frequently with the mesothoracic than the metathoracic.

The great majority of the structures used in distinguishing and classifying the various species of Diaspidinae are located upon the abdomen. Morphologists are fairly well agreed that the typical

number of abdominal segments present in insects in general is eleven. This number is readily recognized in many generalized species of insects, but a study of the abdomen of several coccids leads to the conclusion that the typical number of abdominal segments for this group is nine. That there has been a suppression of the number of abdominal segments in other groups of insects is easily proven. This suppression of segments may take place at the caudal end, due to the modifications necessary to accommodate the organs for copulation and for depositing the eggs, and at the cephalic end, due apparently to the enlargement of the thorax to accommodate the muscles for the organs of flight and its consequent encroachment upon the cephalic abdominal segments. The explanation of just how this reduction has taken place should be sought, not only among the early nymphal stages of the female coccids but especially among the groups showing less departure from the progenitors of the coccids, the plant-lice and the psyllids.

The abdomen in all diaspidids is divided into two regions, a cephalic segmented region, the preabdomen, and a caudal unsegmented region, the pygidium. The segmentation of the preabdomen is always more distinct on the dorsal than on the ventral aspect. The limits of the segments are generally indicated on each lateral aspect by distinct constrictions. The preabdomen frequently consists of four segments in the adult female, but in the first and second nymphal stages and the adult females of certain genera, one and sometimes more segments form a part of the preabdomen, so that it may consist of five or six segments.

The caudal, strongly chitinized, unsegmented pygidium in the adult female consists typically of four segments. The pygidium is strongly depressed so that the dorsal and ventral aspects are close together. The lateral margins of the pygidium are provided with projections and indentations which are known collectively as the pygidial fringe. It is also designated simply as the fringe but this term has already been used for the marginal band of glassy threads of wax excreted from the octacerores in the *Asterolecaniinae* and should be reserved for this use. The structure generally designated as the pygidium is also known as the last segment or anal plate. The early students of the Coccidae believed this strongly chitinized caudal end of the abdomen represented a single segment and hence the name of pygidium, but it is in fact a complex of four or five segments. The number of segments and their limits can only be approximated because all the coriae or sutures

bounding them are obsolete. The females of the conchaspids have been described as having a pygidium, but between all of their abdominal segments distinct coriae can be identified. While the pygidium of the Diaspidinae has probably been derived from a progenitor with an abdominal structure similar to that of the Conchaspinae, yet the form of abdomen found in this latter group can not properly be designated as a pygidium.

The wax in the great majority of the Diaspidinae is poured out through openings which are located in the external cuticle. They are the external outlets of cuticular tubes. These tubes vary greatly not only in length and diameter but in the size and shape of their external openings. Each of these tubes is known as a *ceratuba*. It is not known just how the *ceratubae* function, whether they serve simply as passage ways for the wax or whether they serve as reservoirs into which the wax, as it is elaborated, is stored until the insect is ready to use it. The *ceratubae* are formed by an invagination of the body-wall. The inner end is truncate and always bears on its ental surface a minute knob or nipple, the *bulla*. Whether the *ceratubae* and the cuticular wax tubes found in the Eriococcinae, Kermesiinae, Lecaniinae, and Asterolecaniinae have a common origin is not known, but the presence of the *bulla* in the *ceratubae* readily distinguish those of the Diaspidinae from the wax tubes of the other subfamilies. There is a lumen extending through the *bulla* which connects with the lumen of the *ceratuba* and it is through this lumen the wax is poured into the *ceratuba*. The *ceratubae* and their external openings are also known as *fusi*, *filieres isolate*, *filieres separeé*, *filieres isoleé*, *tubuli*, *tubular spinnerets*, *dorsal tubular spinnerets*, *orifici delle grosse filiere marginale*, *fuse marginales*, *elongated pores*, *oval pores*, *marginal pores*, *spinnerets*, *dorsal glands*, *dorsal gland orifices*, *wax ducts*, *elongated pores*, *marginal gland openings*, *semi-lunar marginal pores*, *marginal lunar pores*, or *dorsal pores*.

There are several types of *ceratubae* in the Diaspidinae and each type seems to be more or less characteristic of certain groups of genera. The external opening of each *ceratuba*, located in the external cuticle, is an *oraceratuba*. This opening, which is usually small, is the external opening of the *ceratuba* and not a *ceroris* or wax pore or pygidial wax pore as it has been generally considered and described. The *ceroris* of the *ceratuba*, if present, would be located at the opposite or inner end adjacent to the *bulla*. The great majority of the *oraceratubae* are located on the dorsal aspect.



They are also known as macropores and micropores. In the genus *Chionaspis* and its allies, the number of oraceratubae on each side of the meson is sometimes designated by the use of a formula in the same way that the number of plates are sometimes indicated. There are at least six types of ceratubae.

The altaceratubae are found in the *Lepidosaphini*, *Diaspidini*, *Parlatoriini*, and *Fioriini*. They are the large broad cylinders, the mouths of which are usually oblique and located at or near the margin of the pygidium.

The brevaceratubae are of the same general form as the altaceratubae, but they never open at the margin of the pygidium. Their oraceratubae are never oblique and they are always much shorter and smaller in diameter than the altaceratubae. They are usually about as broad as long and their oraceratubae are generally known as dorsal pores or dorsal tubular spinnerets.

There is of common occurrence in the pygidia of the *Aspidiotini* long slender ceratubae in which the two sides are parallel or nearly so. They are sometimes fifteen or twenty times as long as broad. These are the linaceratubae, the wax ducts of Comstock and others, and their oraceratubae are sometimes designated as macropores.

In the pygidia of the *Aspidiotini*, there is in addition to the linaceratubae, other ceratubae which are as long or longer than the linaceratubae, but in which the greater part of the tube is reduced to a fine thread. The inner truncated end of these ceratubae which bears the bulla is much larger. This enlarged inner end gives these ceratubae a distinct club-shaped or clavate appearance and they are consequently known as the clavaceratubae.

In addition to the linaceratubae and clavaceratubae, there are other long slender ceratubae in the pygidia of most *Diaspidinae*. These are the lamaceratubae. They differ from all other ceratubae in that their oraceratubae are always located in the distal end of a plate or pectina, projections of the pygidial fringe.

The lateral portions of the segments of the preabdomen bear projections which are known as bracteae. They are not only similar in general form to plates or pectinae but are undoubtedly their precursors and bear oraceratubae at their free end. The ceratubae opening through the bracteae are paraceratubae. They are, so far as observed, always short slender tubes that are ordinarily so slender and delicate as to be identified only with great difficulty.

To Berlese belongs the credit for determining and describing the structure of the cells forming the threads of wax in the Diaspidinae. These cells are modified hypodermal cells but are very different from the flask-shaped cells connected with the spiracerores and genacerores which excrete powdery or pulverulent wax. The thread excreting cells are long and club-shaped, each connected with the ental surface of the ental or free truncated end of a ceratuba. Each ceratuba bears a group of three cells, known as a diaspicera, one of which is supposed to excrete the wax and the other two a covering for the wax. The wax cell, the silk gland or ghiandola sericipara of Berlese, is attached to the end of the bulla. The other cells, the ganogene cells, the ghiandole ganogene of Berlese, are also attached, one on each side of the wax cell, to the bulla. There are openings in the bulla through which the excretion of these cells is poured. The structure of the wax cell is anomalous, according to the account and figures of Berlese they are more like a multicellular gland in structure than a single cell. The distal portion of this cell or the secreting portion is flask-shaped and contains a single large nucleus. The secreting portion is connected by a greatly elongated neck-like or tubular portion through which the excretion is passed to the bulla and ceratuba. The tubular portion of the cell adjacent to the bulla is thickened and striated and apparently functions for compressing the thread of wax in somewhat the same way that the press of the silk duct in lepidopterous larvae compresses the two components of each thread. The ganogene cells are about one-fourth the length of the wax cell. Each consists of a distal, club-shaped, excreting portion which contains a single nucleus. There is a short tubular portion connecting the excreting portion with its opening in the bulla. Berlese believed that the function of the ganogene cells was to excrete a substance which was used for coating or covering the exterior of the threads of wax. If this suggestion is correct, the threads must be fully formed when they make their exit from the bulla into the ceratuba and this latter structure can serve only as a reservoir for storing the threads. The attachment of the cells to the ental surface of the ceratuba would suggest that the bulla and associated parts might be a ceroris that had been invaginated. These structures were figured by Childs, but no discussion of his conclusions is given.

The portion of each lateral margin of the pygidium extending on each side from the coria forming the cephalic limit of the pygidium to its cephalic lobe, second, third, fourth, or fifth as the case may be, is known as a lateris. It is also known as the pygidial margin, lateral margin, thickened lateral margin, margo lateralis pygidii, or simply as the margin. The lateres should not be confused with the pygidial fringe, of which it is the cephalic part.

Each lateris frequently contains indentations bounded by projections which are lobe-like in form. These projections, the latadentes, bounding the indentations in the lateres have been designated as the lateral teeth by Marlatt. The term latadentes is applied to all the tooth-like projections cephalad of the cephalic pair of lobes. In certain genera, as *Diaspis*, *Chionaspis*, *Lepidosaphes* and their allies, all of a considerable part of the latadentes bear the oraceratubae of altaceratubae. Each of these together with the tooth bearing it has been called a gland bearing prominence by Cooley and others. The margin of each lateris, whether the latadentes are present or not, may be finely or coarsely dentate or denticulate. The denticulations bear no relation to the latadentes. In those tribes provided with altaceratubae, the oraceratubae of those located between the lobes sometimes open in tooth-like projections. These are also known as latadentes.

The margin of the pygidium generally contains a number of distinct indentations or notches, the incisurae. They were so named by Leonardi, but are also known as echanerures, incisions, incised notches, interlobular incisions, or simply as notches. It is believed that the incisurae mark the points on each lateral margin where the coriae reached the margin and, therefore, limit the segments. In those species where the pygidial fringe is well developed, the full number of incisurae, five, can usually be identified, but they are greatly reduced or wanting where the pygidial fringe has been wholly or in great part eliminated. This is particularly true where the lateres are long and well developed as in most species of *Aspidiotini*. The pygidium of those species where the adult female does not escape from the last nymphal exuviae, as in the species of *Aonidia*, the incisurae are obsolete. They are named, beginning with the one on the meson between the median pair of lobes as the median or first incisura, the next one on each side cephalad of the median incisura and the median

pair of lobes as the second incisura, and the next on each side as the third incisura, the fourth, and the fifth. There is some discrepancy as to the way in which the incisurae are numbered. Most writers designate the median incisura as the median or mesal and then number the others. A few writers number all the incisurae and such writers always begin with the median. Most of those who designate the first as the median do not designate the next, the one between the median and second lobe of each side as the second but as the first, the one between a second and third lobe as the second, and the one between a third and fourth lobe as the third, and so on. The median incisura is disregarded in numbering the others. This method has not been followed.

There are distinct thickenings associated with the incisurae in certain species. These thickenings are located on the ventral aspect and may be known as the densariae. A furrow extends cephalad from the bottom of one or more of the incisurae onto the ventral surface of the pygidium and one or both sides of each of these furrows may be thickened. The thickenings are usually club-shaped in outline with the clavate portion at the cephalic end. The number of incisurae with densariae is usually less than the total number of incisurae present. There are frequently more pairs of densariae present than there are pairs of lobes. The densariae are only rarely associated with the median incisura. Comstock, who was the first to make use of the densariae in taxonomic work, called them incisions with thickened edges. They were designated as paraphyses by Leonardi and Marlatt, but these structures are confined to the dorsal aspect. The furrow between the densariae, when there is one on each side of the incisura, is frequently provided with a row of prominent oracera-tubae.

The broad or elongate semioval projections of the pygidial fringe are the lobes. They are also known as trullae, pallae, lobules, lamelles, or palette, and are also designated sometimes as the primary lobes to distinguish them from the pseudolobes described later. The lobes are typically arranged in pairs and separated by incisurae, although, through the absence of the mesal incisura and the fusion of the mesal pair, this is sometimes apparently untrue. The lobe on each side of the median incisura is a median lobe, the two being distinguished as the median pair of lobes. They are also known as the mesal or anal lobes. The lobes cephalad of each median lobe are known collectively as the lateral

lobes. The lobe cephalad of each second incisura is a second lobe, that cephalad of a third incisura is a third lobe, that cephalad of each fourth incisura is a fourth lobe, and that cephalad of each fifth incisura is a fifth lobe. The lobes cephalad of each median lobe are sometimes numbered, beginning with the second lobe, as the first lateral lobe, second lateral lobe, third lateral lobe, etc. The lobes of the two sides are grouped together in pairs and designated as the second, third, fourth, and fifth pairs of lobes. The maximum number of pairs of lobes is five, when there is more than this number, the cephalic so called lobes are lobe-like latadentes. The usual number of lobes is three, two, or a single pair. The median lobes are generally the broadest and longest and each successive pair is smaller and smaller until it becomes difficult to distinguish the greatly reduced lobes from the latadentes. The number of latadentes is greatly increased in certain species or until such species are said to have ten or more pairs of lobes present. A projection is not considered as a lobe in the following descriptions unless it projects beyond the general outline of the margin of the pygidium and has associated with it the other structures of the pygidial fringe, plates and pectinae, which are usually associated with lobes. The lobes when greatly reduced in size frequently become narrower and in certain species are long, blunt or pointed, spear-shaped projections. The lobes, even when greatly reduced or plate-like in form, are never provided with oracratubae. The median lobes are sometimes adjacent on the meson so that the median incisura is linear or they may be fused for a part of their length so that it is represented as a distinct notch or they may be completely fused forming a single lobe and effacing the median incisura.

The lobes vary considerable in form. The simplest type is where the margin of the lobe is without indentations and in such cases is said to be entire. Where there is one or two indentations in the distal portion, the lobe is said to be notched. The notch on the mesal side of the lobe is the median or mesal notch and the one on the lateral side is the lateral notch. Either the mesal or the lateral notch may be wanting. When there are a few notches, more than two in the margin of the lobe, it is said to be crenulate and when there are many notches to be serrate. The notches in the crenulate or serrate lobes are always smaller than in the ordinary notched lobes. A lobe may be divided into two distinct parts by an incision, when it is said to be incised or

emarginate. Sometimes there may be two or more incisions so that the lobe is divided into three or more parts. Each of these subdivisions is described by some authors as a distinct lobe, they are best known as lobelets and numbered in order beginning with the mesal one. The mesal lobelet, when there are only two is generally larger than the lateral, if there are more than two, the lateral lobelets are usually successively smaller than the mesal.

The margin of the pygidium in those species that transform in a puparium or do not escape from the last nymphal exuvia, as the species of the genus *Aonidia*, may bear a few or a considerable number of lobe-like projections. These lobes are frequently asymmetrically arranged and are not homologous with the lobes of those species not transforming in a puparium. Such projections are known as pseudolobes. The development of the species transforming in puparia has been so greatly accelerated, that true lobes are usually not found in the pygidium of the adult female but in the pygidium of the second nymphal stage and in some species only in the pygidium of the first nymphal stage. The pseudolobes are not only inconstant in different individuals of the same species but may be different on the two sides of the same individual. The exuviae of the second and first nymphal stage of these species should be mounted for a study of the true lobes and the other parts of the pygidial fringe.

The thin projections with toothed or dentate ends located in the incisurae between the lobes and upon the lateres are known as pectinae. This name was given these structures by Leonardi. They are also known as squamae, squames, pols, squameaux, petinii, scaly hairs, notched plates, serrate plates, serrated ducts, serrulate plates, fimbriate plates, fringed plates, and furcate plates. The pectinae are considered as extensions of the lateral margin of the pygidium. They differ from the lobes in that there is always an oracreratuba located in the distal end of each. The pectinae are regarded as the primitive form of these projections and not the plates as is held by those who consider the plates as developed from setae and the pectinae as developed in turn from the plates. While there is considerable variation in the number and arrangement of the pectinae, their usual disposition is two in the median incisura, two or three in each second incisura, usually two, and two or three in each third incisura, usually three. The pectinae also vary in form, but are readily arranged in four

groups; in the first group they are broad, the distal end is truncate or subtruncate and the teeth are limited to the distal end. These are the distapectinae and are of general occurrence in the Parlatoriini. In the second group the shaft may be comparatively broad or narrow, the distal end is pointed, so that each pectina is subtriangular in outline and the teeth are arranged along both sides of the shaft. These are the latapectinae. In the third group the pectinae are similar in size and form to those of the second group, but the teeth are limited to one side of the shaft. These are the unapectinae. The fourth group includes those pectinae in which there has been the greatest amount of reduction, those with a slender shaft with two or three small inconspicuous teeth at the distal end. These are the furcapectinae and are generally indicated as furcate plates by systematists. The latapectinae, unapectinae, and furcapectinae are all found in the Aspidiotini.

The thin cuticular projections with pointed ends located in the incisurae between the lobes are the plates. They are also known as lamellae, gland spines, spine ducts, fusi piliformis, or fusi spiniformis. The plates are considered as having been developed from pointed pectinae by the loss of their lateral projections or teeth. They are similar in number and position to the pectinae and like them each bears an oraceratuba at its distal end but it is generally more difficult to identify the oraceratuba than the cylindrical part of the ceratuba extending through the cavity of the plate. If the plates and pectinae are continuations of the margin of the pygidium, each is typically provided with a lumen which is a continuation of the lumen of the body. The plates are frequently minute and often difficult to distinguish from setae, the spines of most authors. It is not strange, therefore, that they have been sometimes confused with setae, but they can always be distinguished from setae by the absence of a calyx.

The number of plates and pectinae located in each of the incisurae is of great value in the separation of species. Cooley has suggested that for the sake of brevity the number of plates be indicated in the form of a formula, but this scheme is just as serviceable in indicating the number of pectinae. The formula is written, as follows: 1-0, 1-2, 3-3, 1-2, 2-2, 3-7. The first group of numbers shows the number of plates or pectinae in the median incisura, the cypher indicating their absence, the second group those of the second incisura, the third group those of the

third incisura, the fourth group those of the fourth incisura, the fifth group those of the fifth incisura, and the sixth group those located on each lateris. Since the number of lobes and incisurae is usually three or less, this formula would also indicate the number of incisurae, for if there was only a single incisura present, the formula would consist of only two groups, if of two incisurae of three groups. Such a formula, 0-0, 1-3, 2-5, would show the presence of two incisurae, the absence of plates or pectinae in the median incisura, the presence of one to three in the second, and the presence of two to five on the lateris. The formula also suggests the number of lobes present.

In many of his descriptions Lindinger has abbreviated by indicating many facts as to the pygidial fringe by the use of a formula. This is well illustrated by the use of the one he gives in "Die Schildlaus" for *Chionaspis euonymi*, as follows:  $0P_1; L_1; 2P_2; Dr-m; 2L_2; 2P_3; Dr-m; 2L_3; 2P_4; 2Dr-m; 2-3P_5$ . Translated, this formula means, no plates in median incisura, median pair of lobes present, two plates and oracreratuba on a latadentis in each second incisura, second pair of lobes present and incised, two plates and an oracreratuba on a latadentis in each third incisura, third pair of lobes present and incised, two plates and two oracreratubae on latadentes in each fourth incisura, and two to three plates on each lateris.

The arrangement of the plates on the lateres in the Lepidosaphini, Parlatorini, and Diaspidini is such in many species as to suggest a segmental arrangement. The cephalic group, particularly in the Diaspidini, generally contains the largest number. Where these plates are separated so that each must be considered separately or where the plates of the other groups are separated, those of a group are enclosed in a parenthesis. The groups of plates on each lateris are separated by hyphens. The following shows such a formula: (1-1)-2-2-(1-1-1-1).

The proximal portion of each of the lobes or the surface of the marginal portion of the pygidium adjacent to the lobes and the lateres adjacent to the latadentes usually bear small setae, the pygidial setae. These setae are generally constant in number and position for a given species and are usually designated as spines. Some of the setae are located on the dorsal aspect and others on the ventral and for this reason they are some times designated as the dorsal or ventral setae. There are a few species in which a second row of setae, the submarginal setae,



have been identified on the ventral aspect a short distance cephalad of the pygidial setae. The pygidial setae vary somewhat in size. They are sometimes so large and so placed as to be mistaken for plates, particularly in the median incisura when it lacks plates or pectinae. But the insertion of each seta in a calyx should remove any doubt as to its identity and structure. They are also known as spines, poils, hairs, pili simplices, or pili simpliciter. The dorsal and ventral setae appear in generalized species to be segmentally arranged.

In the region of the vulva there is located a varying number of minute clear rings or spots. These rings are of quite general occurrence in many species, but they are especially distinct in most species of *Lepidosaphini* and *Diaspidini*, and, where ever they occur, their presence is usually easily determined. There are four to six located just cephalad of the vulva, which are situated on the ventral aspect; there is another pair located slightly farther caudad which are situated on the dorsal aspect; there is sometimes another pair located cephalo-laterad of each group of pregenacerores which are situated on the dorsal aspect; there is one or more pairs located between this last pair and the proximal ends of the lobes which are situated on the ventral aspect; and there may be a considerable number near the caudal margin of the pygidium which may be situated on the dorsal or the ventral aspect. All of these clear spots have been considered by some writers and a part of them by other writers as micropores or the openings of wax-pores, that is minute oraceratubae. The shaft of a seta, although in most cases extremely minute, has been identified in every instance where these micropores have been carefully examined with an oil emersion objective. The rings are, therefore, not wax-pores but the calices of setae. I was gratified after this conclusion was reached to discover that Green figures these structures as setae.

There are in certain species near the proximal ends of the lobes distinct club-shaped thickenings, which are known as paraphyses. They are also known as thickenings of the body-wall, club-shaped thickenings of the body-wall, processes, elongate thickenings of the body-wall, or processi chitenosi. They vary greatly in size and form even in the same species. Their number, size, and form afford excellent characters for the differentiation of species. The paraphyses are thickenings of the cuticle of the dorsal aspect as was demonstrated by Comstock and differ

in this respect from the densariae which are confined to the ventral aspect of the pygidium and are never present, so far as observed, in those species provided with paraphyses. These two very different structures are confused by Leonard and Marlatt under the single name of paraphyses. The paraphyses are continuous, at least for the most part, with the proximal prolongations of the lobes while the densariae are always located between the lobes. The number of paraphyses associated with each lobe varies, one to three are the usual numbers, but there may be more than three and some of the lobes may lack them, if wanting, it is usually from the mesal lobes. There is frequently a considerable number present in a single pygidium, as many as twenty-eight or fourteen pairs in some.

The anus in the Diaspidinae is the prominent opening located on the meson of the dorsal aspect, frequently near the middle of its length and usually some distance from the caudal end of the pygidium. It is normally located in the caudal abdominal segment, but the depression of this part of the body, the close apposition of the dorsal and ventral aspects, and the consequent reduction in the lumen between these areas, the anus has migrated cephalad and is found in the cephalic portion of the pygidium of certain species. The anus is also known as the anal opening or anal aperture.

The external opening of the female reproductive organs, the vulva, is apparently constant in position in the Diaspidinae. It is situated on the ventral aspect of the pygidium in the region of what is believed to be the sixth segment. The position of the vulva is often difficult to determine, but is generally more easily identified because of the structures associated with it, the genaeccerores, when these are present, and the fine radiating ridges in the surface of the cuticle. The vulva is also known as the vaginal opening, genital aperture, genital orifice, aperture sessuale feminae, or genital otvor.

Figures of pygidia usually show the position of the anus and vulva as if they were both on the same aspect. The comparative position of the anus and vulva, their distance from each other and from the caudal margin of the pygidium, is of considerable value, but the fact that they are situated on different aspects must not be overlooked. The variation in position between the anus and vulva is due wholly or for the most part to the difference in position of the anus. In the Parlatoriini the anus is

usually located midway between the vulva and the caudal margin, but in *Gymnaspis* they are superimposed; in the *Lepidosaphini* the anus is situated far cephalad of the vulva, the latter is frequently located on a line drawn through the caudal margin of the postgenacerores and the anus some distance cephalad of the mesogenacerores; in the *Diaspidini* the anus may be located caudad of the vulva, superimposed, or cephalad, but is usually placed near to or slightly cephalad of the vulva; in the *Pioriniini* the anus is usually placed cephalad of the vulva, frequently about its own diameter, rarely slightly caudad; in the *Aspidiotini* the anus is situated caudad of the vulva, the distance varying with the genus and the species, in some it is located adjacent to the proximal ends of the median pair of lobes, in others midway between the vulva and the caudal margin, or nearer to the vulva. In measuring this distance, where reference is made to the caudal margin, the distal ends of the median pair of lobes is always used and not the bases or proximal ends of these lobes. In making such measurements account must be taken of the fact that the anus is not always round, the length may be two or three times the width, in all such cases it is the transverse diameter or width that is used.

The mesal portion of the caudal margin of the pygidium is deeply emarginate in certain species. This is variously described as emarginate, indented, notched, deeply concave, or semicircularly or concavely hollowed out. This emargination involves more than the median incisura, because it is frequently of such size that the median lobes are situated for the most part within the emargination. These lobes are usually strongly oblique, the lateral margin of each is fused to the pygidium, and only a small portion of the distal end of each median lobe projects beyond the general contour of the pygidial margin. This emargination is known as the median notch or pygidial incision.

The dorsal surface of the pygidium cephalad of the anus sometimes contains a reticulated area. This area may be of some size and cover a considerable part of the cephalic portion of the pygidium or it may be very small in extent. The reticulations are closely crowded together and the appearance is due to the thickenings of the margins of the small areas. Green has compared the pattern of the reticulations to that of crocodile-leather. Their pattern and shape are responsible for their name of lattice-shaped thickenings. The functioning of these thickenings is not clear and they have evidently arisen independently several times

since they occur in widely separated groups.

There is located in the cephalic region of the dorsal aspect of the pygidium of certain species a curved transverse band of thickenings which were named by Leonardi the calli and here designated as the calles. They are the transverse thickenings of Marlatt and the basal thickenings of Dietz and Morrison. The calles exist in four conditions. There may be four distinct separate thickenings, two on each side of the meson, the one on each side adjacent to the meson is known as a mesal callis and the one laterad of each mesal callis as a lateral callis; there may be a transverse band of three thickenings, the mesal one much longer than either of the lateral and evidently formed by a fusion of the mesal calles; there may be a transverse band of two thickenings, one on each side of the meson, each evidently formed by a fusion of the mesal and lateral calles of a side; or there may be a single transverse thickening, evidently formed by a fusion of the two mesal and two lateral calles.

In certain species there are thickenings which appear to be proximal prolongations of the lobes. These thickenings extend through the cuticle and for some distance beyond the proximal ends of the lobes. They are characteristic in form for certain species and only of certain individuals of other species. They seem to vary considerable in extent and appearance depending upon the amount of treatment given the specimen with caustic potash. They are designated as anomaladensae to distinguish them from the other thickenings of the pygidium. They are incorrectly designated as ventral thickenings by some writers.

On the ventral aspect of the pygidium of many species, there are more or less distinct thickenings that are similar in general appearance to the calles, but they are situated on the ventral aspect and extend longitudinally instead of transversely. They may be known as the paradensae and in common with some of the other thickenings of the pygidium have been previously called ventral thickenings. The paradensae are located laterad of the vulva, but vary somewhat in position. They are more frequently located on the mesal than on the lateral side of the genacerores. In some species they are located mesad of the postgenacerores and laterad of the pregenacerores. In such cases there are two portions which may be connected by an oblique thickening or the connection may be wanting. If necessary to distinguish these two portions of each side, the cephalic portion may be known as a preparadensa and the caudal as a postparadensa. The portion

laterad of each pregenaceroris, the preparadensa, is sometimes wanting, the postparadensae are always so far as observed more distinct than the preparadensae. The paradensae are generally obsolete in species lacking genacerores.

The cerores located on the ventral aspect near the meson and the middle of the pygidium are the genacerores. They are, so far as known, peculiar to the adult females of certain species of Diaspidinae, but they may be homologous with the cerores which are peculiar to the vulvular region of certain adult females of other subfamilies. The genacerores are also known as filieres, spinnerets, circumgential glands, circumgential gland openings or orifices, circumgential pores, ventral glands, grouped glands, ventral grouped glands, wax glands, fusi, filiere aggregate, disculi ciripari, disculi ciripari perivulvarea, plaque de filieres, dischiciripari, or paragenitals.

The genacerores are usually arranged in four or five groups. When there are five groups present, one group is located on the meson cephalad of the vulva and two groups on each side laterad of the vulva. The mesal group, the mesogenacerores, is variously designated as the anterior, mesal, median, or upper group. The cephalic group of each side, the pregenacerores, is variously known as the anterior-lateral group, cephalo-lateral group, upper lateral group, cephalolateral group, or the anterior laterals. The caudal group of each side, the postgenacerores, is variously known as the posterior lateral group, the caudo-lateral group, lower lateral group, caudolateral group, or posterior laterals.

In the following descriptions of species, the maximum and minimum number of cerores in the groups of genacerores are indicated in the following way: 0-9 (20-25) 10-19 or (7-9)2-6. The first group of numbers in front of the parenthesis shows the number of mesogenacerores, none to nine, the second group, always enclosed in a parenthesis for this group, shows the number of pregenacerores, and the third group the number of postgenacerores. Where only two groups of numbers are shown, the first group is included in parenthesis and represents the number of pregenacerores and the other the number of postgenacerores, the mesogenacerores being wanting.

The number of cerores in the groups of genacerores are indicated by different authors by the use of formulae of various forms. Those of Leonardi are indicated thus:

$$\frac{14}{24-24 \text{ Or } \frac{6 \times 5}{15-17}} \text{ Or } \frac{17-21}{2 \times 2 \text{ Or } \frac{8-13}{8-13}}$$

These translated into the form just given, would be: 14(24-24) 15-17 or 3(5-6)2-2 or (17-21)8-13. The most intricate formulae are those used by Lindinger. The following are a few samples translated in each case to the form given in the preceding paragraph: 5-9: 5-10: 5-7: 5-10: 5-9 equals 5-7(5-10)5-9; 23: 27: 19: 32: 19 equals 19(27-32)19-23; 1-4: 1-4: 0: 1-4: 1-4 equals (1-4) 1-4; 0: 0-2: 0-2: 0 equals 0(0-2)0; 10: 11 10: 9: 8; 4: 10: 8: 7: 9; 10: 18: 11: 15: 10 equals 10(9-11)8-10 and 8(7-10)4-9 and 11(15-18)10-10. The last formula is to show the number in three individuals. If colons have been accidentally substituted for the semicolons in the printing, as sometimes happens, there is difficulty in the interpretation of the formula unless one is familiar with the underlying principal of the construction of the formula. Each formula is apparently to consist of five groups of numbers separated by colons, a group of numbers for each group of genacerores, and the second five groups of numbers, whether separated by a semicolon from the first five groups or not, represents another individual and is a different formula.

The mesogenacerores usually have fewer cerores than either of the other groups and are frequently wanting or represented by one or two cerores. They sometimes combine with the pregenacerores and form a single large crescentic cephalic group. Such a group is known as a solaceroris. The postgenacerores being distinct, in such cases, the pygidium is said to have three groups of genacerores. The pregenacerores and the postgenacerores sometimes combine forming a single elongate group on each side of the vulva. The group of each side is known as a latagenaceroris. The pygidium in such cases is said to have three groups of genacerores if the mesogenacerores are present and two if they are wanting. In a few cases the genacerores form a large U-shaped group, from their form evidently arising from a fusion of all five groups of genacerores, the omnigenaceroris. When two or more groups of genacerores combine or fuse they are sometimes described as genacerores confluent. There are in certain genera as *Poliaspis*, more than five groups of genacerores present. In certain species of this genus, as *media* Maskell and *cyeadis* Comstock, the three extra groups of genacerores appear to be groups of cerores of the abdominal segments cephalad of the one bearing the mesogenacerores. In other species the extra groups appear to have been formed by the subdivision of some

of the primary groups. This latter method may have been the original method of formation and the appearance in the species named may be due to a reduction in the number of cerores and their later migration and isolation.

The number of cerores in each group varies greatly. There may be only a few, as one, two, or three, or there may be forty or more. This variation in the number of cerores, unfortunately is not fixed even within specific limits, but the comparative number in a group is often of value in separating species or groups of species.

Each genaceroris is a disk-shaped ceroris with several irregularly arranged comparatively large openings. The fact that they are present only in the adult is of value in those species possessing them in deciding whether a given individual is an adult or a second stage female nymph. The genacerores were originally considered as forming a considerable part of the scale and because of this belief they were named spinnerets. They excrete a fine powdery wax which is mixed with the eggs as they are extruded. Green has called attention to the fact that most of the species provided with genacerores lay eggs, while those species without these structures give birth to living young. Those species provided with genacerores and giving birth to living young possess only a very few cerores in each group. The genacerores are similar in structure to the spiracerores, but in certain species have a fewer number of openings than the genacerores. The fact that the genacerores are present only in the adult female and their location about the vulva would suggest that they must be homologous with the cerores peculiar to other adult females, certain eriococcids, and from which the wax for covering the eggs is excreted.

Each female and male of the Diaspidinae is covered by a thin sheet or pellicle known as a scale. It is frequently incorrectly designated as a puparium. This term should be applied only to the last nymphal exuvia in which the adult female of certain coccids, as the females of the genus *Aonidia*, pass their life and the last larval cuticle or exuvia in which the pupae of certain Coleoptera and Diptera complete their pupal life. The scale is composed of three distinct products, the molted skins or cuticle of the first and second nymphal stages in the female and the first in the male, a mass of threads of wax which are poured from the oraceratubae and fuse upon coming into contact with each other, and according to Berlese to a mass of excretion formed by the

Malpighian tubules and poured out through the anus. In the case of the dark or blackish scales the coloring matter is located in the excretion from the Malpighian tubules. The remarkable white varieties, as in the case of *Lepidosaphes ulmi candida*, are imperfect individuals which were unable to produce the secretion necessary to color the scale. It is not unusual to find individuals in large colonies containing many individuals in which the cephalic half of the scale is normal in color, black or brownish, and the caudal half is white or uncolored.

The English and some other writers usually designate the exuviae as the pellicles, the first exuvia as the larval pellicle and the second exuvia as the nymphal pellicle. Most American writers usually employ a word derived from the Latin word *exuviae*, which was used by the Romans to designate the cast off skin of animals. It was used in the plural only. Some writers apparently do not differentiate between the cast skins of the first and second nymphal stages and always use the word *exuviae* but evidently only in the plural form. Comstock and Cockerell employ the word *exuviae* for both female and male scales, evidently using it in both a plural and a singular sense. Some have used a neuter form, *exuvium*, for the singular and the regular plural form, *exuvia*. These forms have found their way into the American dictionaries. Ferris writes of the first *exuvium*, the second *exuvium*, and the *exuviae*. So far as observed, Cooley was the first to use the singular form, *exuvia*. He is followed in this by Marlatt. The regular Latin singular of *exuviae* would be *exuvia*. These forms have been adopted.

The scale consists of two parts, a dorsal scale, sometime simply designated as the scale, and a ventral scale. The ventral scale is frequently very thin and adheres closely to the surface of the host-plant, but it may be well developed and fused with the dorsal scale. As each exuvia is molted, it is secured to the sheet of wax of which the scale is formed by a coating on its inner surface. As the second exuvia is cast later, this explains its position under the first, but there is always a sheet of wax between them. In the case of those aspidiotids which rupture their exuvia around the margin of the body, the dorsal portion of the exuvia is imbedded in the dorsal scale and the ventral portion in the ventral scale. Because the ventral portion of the exuvia is thin and delicate, it is frequently overlooked, but in many cases where the ventral scale is very thin, it is likely that the ventral portion of the exuvia is lost. In all other Diaspidinae



the first exuvia remains in a single piece and since the antennae remain attached to the dorsal portion of the exuvia, it is possible, unless they have been broken off by the elements, to identify the antennae on the first exuvia of the adult scale. The presence or absence of the antennae on the dorsal portion of the first exuvia may prove of value in determining the tribal location of a given species.

The scales vary greatly in shape. In some species the exuviae are nearly as large as the entire scale, while in others they are not only much smaller but form only a small portion of the scale in comparison with the much greater extent of the wax or excreted portion. Where the scales are elongate, the exuviae are placed at one end and usually project beyond its margin. The portion of the scale bearing the exuviae is always narrow and the scale gradually widens toward the caudal end. In the circular scales the exuviae are usually placed within the periphery and in the Aspidiotini, which usually have this type of scale, they are located at or near the center of the scale. The body of the insect is generally located under or near the exuviae.

The young nymphs of the first stage usually form a minute ball or button of threads of wax as the first part of their scale. This becomes melted into a compact mass and can be identified as the minute dot over the first exuvia of the scales of many adult females. This dot may be known as the cicatrix. Comstock has described and figured the peculiar rolls of cicatrices formed by certain individuals which do not get beyond this stage in the formation of their scale.

The scales of all adult females contain typically two exuviae. A few genera in most of the tribes as Aonidia do not molt their second exuvia, but shrink away from it and transform to adults within it, using this second exuvia as a puparium which consequently never becomes attached to the scale. Some of the species transforming in a puparium, particularly those with a long or pyriform scale, have a transparent scale so that the puparium can be identified through the scale and from its position appears to be the second exuvia. With the exception of these genera, the presence of a single exuvia indicates that the enclosed insect is in the second nymphal stage if a female or if a male, that it is in any stage after the first nymphal stage. The scales of the males are always much smaller than those of the adult female, are usually quite similar to those of the second nymphal female, and are always provided with a single exuvia. In a few genera as

*Diaspis*, *Aulascapis*, *Chionaspis*, etc., the male scales are easily identified because the secretionary portion is frequently distinctly longitudinally carinate.

The tribes of Diaspidinae, of which there are six, have been arranged in the order of the following tabulation which indicates something not only as to the relation of the tribes but of their lines of specialization:—

### SYNOPSIS OF THE DIASPIDINAE

GENERALIZED DIASPIDINAE.—Pygidium with *Altaceratubae*.

Pygidium with *Pectinae*.

Preabdomen with *Bracteae*. -----

1. The Fringed Scales.—*PARLATORIINI*.

Preabdomen without *Bracteae*. -----

2. The White-shield Scales.—*LEUCASPIDINI*.

Pygidium with Plates.

*Brevaceratubae* Conservers.

*Altaceratubae* opening near Margin. -----

3. The Oyster-shell Scales.—*LEPIDOSAPHINI*.

*Altaceratubae* opening in *Lata dentes*. -----

4. The Double-shield Scales.—*DIASPIDINI*.

*Brevaceratubae* Loosers.-----5. The Uhlerian Scales.—*FIORINIINI*.

SPECIALIZED DIASPIDINAE.—Pygidium without *Altaceratubae*.

6. The Deltoid Scales.—*ASPIDIOTINI*.

What is considered as the most generalized condition of the Diaspidinae is found in certain species of *Parlatoriini*. The retention of distapectinae in the *Leucaspini*, although they have departed considerably from the condition in the *parlatoriids*, allies them with the latter. The presence of plates allies the *Lepidosaphini*, *Diaspididni*, and *Fioriniini*. In the first two the retention of *brevaceratubae* distinguishes them from the third, while the presence of plates in the mesal incisura of most *Lepidosaphini* shows a more generalized condition than their absence in most *Diaspidini*, but the location of the anus much nearer the caudal margin of the pygidium than in the latter would show a more generalized condition for the *Diaspidini*. The *Aspidiotini* are without *altaceratubae*, have *pectinae* in the generalized genera, plates in the specialized, and the absence of both and the development of pseudolobes in the most specialized.

The *Parlatoriini*, *Lepidosaphini*, *Diaspidini*, and *Aspidiotini* contain among their most highly specialized genera those that transform in a puparium. In the *Leucaspini* and *Fioriniini* all or most of the species transform in this way. There is, except in the last two named tribes, the same line of specialization

shown in all in the modification of the pygidium and the pygidial fringe. The generalized pygidium contains five distinct groups of genacerores, at least three pairs of lobes, and two or three broad distapectinae in each incisura and several on each lateris. The line of modification is a transformation of the pectinae into plates, a reduction in the number of plates, a reduction in the size of the lobes, and finally in the number of lobes. The modification proceeds always along each side of the pygidium from the cephalic end to the meson or caudal end. With the reduction in the pygidial fringe there proceeds also a reduction in the number of cerores in the groups of genacerores and finally their complete loss. One of the highest types of specialization is represented by a few species where lobes, plates, pectinae, and genacerores are wanting and the projections of the pygidium are limited to latadentes. Whether there is an acceleration of the development and in the last named species the pygidial fringe is to be found only in the pygidium of the second nymphal stage is not known. But representing the highest type of specialization in each of the four tribes first named are genera in which the adult female shrinks away from the last or second nymphal skin but never escapes from it. The young are born alive and escape through openings in the cuticle, that is the second exuvia or puparium as it is designated in such species. The pygidium of the adult female may be entirely without projections or bear a large number, none of which are homologous with any part of the pygidial fringe. These projections, the pseudolobes, are frequently asymmetrical. There has been an acceleration in the development of the pygidial fringe and it is frequently found in the pygidium of the second nymphal stage, but in certain species the pygidial fringe is wanting even in the second nymphal stage and is to be found only in the pygidium of the first nymphal stage. The species transforming in a puparium represent the highest type of modification and specialization.

The expression in the following table, of the adult female or of the second nymphal female, does not imply that both of these stages in all species must be examined before the position of any given species can be determined. It should not be forgotten that the characters of the pygidium of the second nymphal female can be secured at all times by mounting the second exuvia of the scale. It does mean, that, if the structure named is wanting in the adult female, the pygidium of the second nymphal female should be examined to determine whether it is present or absent in this

stage. This statement is added so that the species transforming in puparia, if it is known that the species transform in this way, need have only the second nymphal stage examined. Specimens belonging to the various tribes of Diaspidinae can be distinguished by means of the following table:—

## TRIBES OF DIASPIDINAE

- a. Pygidium of adult female or of second nymphal female always with altaceratubae and frequently with brevaceratubae; scale of adult female usually elongate, several times longer than broad with exuviae at one end, if shorter or round, exuviae placed at or just within periphery, exuviae never central or superimposed, placed almost end to end, overlapping slightly; exuvia of first nymphal female with remains of antennae forming porrect appendages; pygidium, if lacking altaceratubae, with elongate scale with single terminal exuvia with porrect antennae.
- b. Pygidium of adult female or of second nymphal female usually with pectinae, rarely with plates; mesogenacerores frequently wanting and, when present, rarely with more than eight cerores; scale of adult female sometimes almost completely covered by second exuvia.
- c. Preabdomen of adult female or of second nymphal female with lateral margins of its segments, at least caudal ones, bearing bracteae; adult female sometimes enclosed in puparium, if not enclosed, pygidium of adult female with distapectinae and altaceratubae, if transforming in puparium, second nymphal female with similar structures; second exuvia of scale of adult female large, often almost covering scale.-----PARLATORINI.
- cc. Preabdomen of adult female or of second nymphal female never with lateral margins of any of its segments bearing bracteae; adult female always enclosed in puparium and frequently without altaceratubae and with furcate pseudolobes, second nymphal female with altaceratubae and distapectinae; second exuvia of scale of adult female moderate in size, not attached to scale, and always less than one-half length of scale. -----LEUCASPIDINI.
- bb. Pygidium of adult female or of second nymphal female usually with plates, at most only with furcapectinae; mesogenacerores usually present and usually with more than eight cerores; scale of adult female with second exuvia always small, rarely if ever, covering one-half of scale.
- c. Pygidium of adult female or of second nymphal female usually with distinct brevaceratubae, irregularly arranged or arranged in transverse rows; adult female rarely enclosed in puparium; pygidium never with linaceratubae or clavaceratubae.
- d. Pygidium of adult female or of second nymphal female with plates between median lobes, rarely wanting; body of adult female always twice or more as long as broad; altaceratubae usually arranged in pairs, rarely opening in latadentes, their

oraceratubae elongate oval in outline, frequently twice as long as broad; scale of adult female elongate, coriaceous, or horny, usually brownish or blackish in color, shaped and ridged like an oyster-shell, exuviae always at one end, sides sometimes parallel or subparallel; scale of adult male never carinate and usually similar in color to that of female.-----

## LEPIDOSAPHINI.

- dd. Pygidium of adult female or of second nymphal female rarely with plates between median pair of lobes; body of adult female always distinctly longer than broad, rarely twice or more as long as broad, if so, always without plates between median pair of lobes; altaceratubae usually arranged singly, frequently opening in latadentes, their oraceratubae circular or subcircular in outline; scale of adult female pyriform, elongate or round, sometimes shaped and ridged like oyster-shell and, if so shaped, always without plates between median pair of lobes, rarely if ever with sides parallel or subparallel, generally white in color or light colored, and closely felted; scale of adult male often longitudinally carinate and chalky in color and appearance.-----DIASPIDINI.

- cc. Pygidium of adult female or of second nymphal female always without brevaceratubae; scale of adult female always elongate and with single exuvia; adult female always enclosed in puparium, excretory part of scale thin and puparium, which is generally nearly as large as scale, apparently forming second exuvia; pygidium sometimes apparently lacking altaceratubae and provided with linaceratubae and clavaceratubae. -----FIORINIINI.

- aa. Pygidium of adult female or of second nymphal female never with altaceratubae, rarely with brevaceratubae, and if provided with brevaceratubae, not arranged in transverse rows, usually with linaceratubae or clavaceratubae; scale of adult female circular or nearly so, rarely elongate, if so, exuviae superimposed; exuviae always central or nearly so, first exuvia superimposed over center of second, never projecting beyond periphery or attached at periphery; exuvia of first nymphal female never with remains of antennae forming porrect appendages; pygidium rarely with distapectinae or furcapectinae, frequently with latapectinae, unapectinae, or plates, if apparently with altaceratubae scale always round with central exuvia and first exuvia without remains of antennae; scale of adult female with second exuvia small and never covering one-half of scale; adult female sometimes enclosed in puparium.-----

## ASPIDIOTINI.

## CHAPTER XXII

### TRIBE PARLATORIINI

#### *The Fringe Scales*

The body of the adult female is usually longer than broad with the cephalic and caudal ends bluntly rounded and with the sides parallel or subparallel or as broad or broader than long with the body triangular in outline and the caudal portion with converging lateral margins and bluntly pointed caudal end. The lateral margins of the segments of the preabdomen are provided with bractae either in the adult female or the second nymphal female. Lobes are present in the adult female or second nymphal female. There are usually three pairs, rarely four pairs, sometimes with the fourth and fifth pairs rudimentary, and sometimes with only two pairs, if wanting, present in the second nymphal stage. Distapectinae are present in either adult female or second nymphal female, rarely reduced until they approximate furcapectinae in form, sometimes wanting in adult female and second nymphal female. Plates are rarely present. Incisurae are broad and shallow, usually completely filled by pectinae, median incisura rarely without pectinae. Densariae or paraphyses are never present. Altacera-tubae are present and are usually very large. Brevaceratubae may be numerous, few in number, or wanting, but are never arranged in transverse rows. Genacerores are present or wanting, when present, represented by four or five groups, the mesogenacerores are generally wanting and, if present, rarely with more than eight cerores. Scale of adult female variable in form, round or almost round with exuviae small and peripheral, subquadrangular with the exuviae large and covering most of surface, or two or three times as long as wide with exuviae at one end. Exuviae usually two in number, female sometimes transforms in a puparium, in such cases with only a single exuvia. Scale of male is usually elongate, twice as long as wide, with the exuvia at one end, rarely subcircular with the exuvia subcentral.

The genera of Parlatoriini fall into two groups, those which are normal in their development and those in which the adult female is enclosed in a puparium. This latter group includes a single genus, *Gymnaspis*. The pygidium in the species of this genus is greatly modified in the adult female. In some there is no indication of lobes, pectinae, or incisurae, but the typical pygidial structures are found in the second stage of the female nymph.

The scale of the adult female varies considerable in form.

It may be elongate, over three times as long as broad; ovate, not quite twice as long as wide; or circular or subcircular. The exuvia overlap and are placed at one end or project beyond the periphery of the circular or subcircular scales. In the ovate scales the second exuvia is very large in comparison to the extent of the wax and forms the greater part of the scale. In the elongate and circular scales the area of wax is two or more times the area covered by the exuviae. The wax of the scale is thin and delicate and usually not strongly colored. The exuviae in a few species are black.

The scale of the male is elongate, two or more times as long as broad with the sides nearly straight and subparallel. The single exuvia is attached at one end and the area of wax is much greater than the area covered by the exuvia. The scale is similar in color to that of the female and its exuvia is sometimes black.

The name of fringed scales is derived from the characteristic appearance of the pygidial fringe of many species, which consists of a continuous margin of lobes and large distapectinae. Equally conspicuous are the large altaceratubae with their oraceratubae located near the proximal ends of the pectinae. The cephalic limits of the pygidium are usually not distinct and there is a gradual mergence of the segments of the preabdomen and pygidium. This is still more striking in the nymphal stages of the female. The dorsal aspect bears numerous brevaceratubae, but they are promiscuously distributed and offer no indication as to the segmentation of the pygidium. There are typically three pairs of lobes present, but this number may be reduced in some species while as many as five pairs can be identified in others. This arises from the fact that in some species the cephalic pairs of lobes are not sharply different in form from the pectinae, in others they are distinctly bluntly or pointedly rounded at the distal end and are lobe-like and not pectinae-like in shape. The pectinae are generally broad and quite constant in number, two in the median incisura, two in each second incisura, three in each third incisura, three in each fourth incisura, and three or four in each of the other incisurae. There are slender lamaceratubae extending through the pectinae. The genacerores are wanting in all of the adult females enclosed in a puparium, while there are four or five groups in the species of other genera. The mesogenacerores are frequently wanting and when present consist of only a few cerores, usually less than eight. There is considerable variation in the number of cerores in the groups of

pregenacerores and postgenacerores, ranging from four to twenty or more. In *Euparlatoria viridis* the pregenacerores and postgenacerores are continuous, form latagenacerores, with only a slight constriction marking the division between the two groups and the pygidium appears, from a cursory examination, to have only two groups of genacerores, each consisting of 23 to 26 cerores.

Species of Parlatoriini are found in all parts of the world, but they are more abundant in tropical and subtropical regions. In temperate regions they are able to survive only on plants grown under glass. Several of the species are pests upon the fruits, trees, and shrubs of cultivated tropical fruits of different kinds.

The only complete account of the species of Parlatoriini is that of Leonardi: "Generi e specie di Diaspiti, saggio di sistematica delle Parlatoriae," published in 1903. This paper is now out of date since many species have been described since its publication. In this work two genera are recognized, *Parlatoria* and *Gymnaspis*. The former genus, *Parlatoria*, which has *ziziphi* Lucas as type, was divided into two subgenera, *Euparlatoria* for which *calianthina* Berl. & Leon. may be taken as the type, and *Websteriella* which has *blanchardi* Targ. as type. Since *blanchardi* and *ziziphi* are congeneric, *Websteriella* must give way to the older name of *Parlatoria*. *Apteronidia* Berl., not Leonardi as given in the Catalogue of Coccidae, was first suggested in 1896 and also has *blanchardi* Targ. as type. The name *Euparlatoria* published in 1900 is antedated by *Syngenaspis* Sule published in 1895 with *parlatoriae* Sule as type. This species of Sule and *calianthina* Berl. & Leon. are congeneric.

The species of *Gymnaspis* are liable to be confused with those of the genus *Aonidia*, a genus of *Aspidiotini*. The second exuvia or puparium in *Gymnaspis* is almost as large as the entire scale and the first exuvia is peripheral instead of central in position. In *Aonidia* the second exuvia or puparium is larger than is usual in the scales of the *Aspidiotini*, but it is much smaller than those of the *Parlatoriini* and in addition the first exuvia is central in position. The practical difficulty in differentiating the two genera is that the first exuvia is lost. It is apparently not firmly attached to the scale. The presence or absence of *altaceratubae* in the pygidium of the second nymphal female or both the second and the first nymphal females needs to be recorded and this character used for identifying the genera of *Aspidiotini* that transform in a puparium. The species of this tribe, so far as observed,



always lack altaceratubae. It is likely that several of the species described as belonging to the genus *Aonida* may be found to belong to *Gymnaspsis* when the pygidia of their nymphal stages are described or figured.

#### GENERA OF PARLATORIINI

- a. Pygidium of adult female with groups of genacerores.
- b. Pygidium of adult female always with lobes and pectinae or plates; adult female never enclosed in puparium.
- c. Pygidium of adult female with four or five groups of genacerores.
- d. Pygidium of adult female always with pectinae and more than two pairs of lobes.
  - e. Scale of adult female with second exuvia of medium size, never covering one-half of scale.-----*Syngcnaspsis* Sulc.
  - ee. Scale of adult female with second exuvia large, covering two-thirds or more of scale.-----*Parlatoria* Targ.
  - dd. Pygidium of adult female without pectinae and with plates; scale of adult female with second exuvia large, covering greater part of scale.-----*Cryptoparlatoria* Lindgr.
  - cc. Pygidium of adult female with two groups of genacerores. —Type, *Gymnaspsis aberemoae* Lindgr.-----*Lindingeria* MacG.
  - bb. Pygidium of adult female always with pseudolobes and without lobes and pectinae or plates; adult female enclosed in puparium. *Porogymnaspsis* Green.
- aa. Pygidium of adult female without groups of genacerores.
  - b. Pygidium of adult female and of second nymphal female with lobes and pectinae; scale of adult female with two exuviae, adult female never enclosed in puparium.—Type, *Parlatoria pseudaspidotus* Lindgr. -----*Genaparlatoria* MacG.
  - bb. Pygidium of adult female with simple or toothed pseudolobes and without pectinae; second nymphal female with lobes and pectinae; scale of adult female with single exuvia, adult female always enclosed in puparium. -----*Gymnaspsis* Newst.

#### SPECIES OF SYNGENASPSIS

- a. Pygidium with five groups of genacerores.
- b. Pygidium with four pairs of lobes, all with distinct lateral notch, fourth pair of lobes small; pectinae broad, two in each incisura, and filling space; genacerores 0.7(10-25)11-23; altaceratubae 19, one mesal and nine on each side; scale of adult female circular or subcircular, white or whitish with yellow to fuscous exuviae.—*Parlatoria* (*Euparlatoria*) *callanthina* Berl. & Leon.—Italy, Algeria on *Rosa*, *Fraxinus*, *Olea*, peach, apple, almond.-----*olea* Colv.
- bb. Pygidium with three pairs of lobes.
  - c. Pygidium with each group of pregenacerores consisting of about twenty cerores.

- d. Pygidium with the median pair of lobes with prominent lateral and mesal notches.
  - e. Scale of adult female oval in outline, pale ochreous, second exuvia black or blackish; pygidium with median pair of lobes with lateral and mesal notches; genacerores 1-1 (20-20)7-7.—Japan, New York on tea, maple.-----*theae* Kkll.
  - ee. Scale of adult female circular in outline, white or grayish, second exuvia dark greenish to black; genacerores 1-4 (9-16)16-17.—Japan on Ilex.-----*theae viridis* Kkll.
- dd. Pygidium with median pair of lobes with inconspicuous lateral notch; second pair of lobes similar in shape with more distinct lateral notch; third pair of lobes broad, truncate; lobes close together, pectinae long and narrow, arranged 2, 2, 3, 6; genacerores 8-10 (20-22)20-22; scale of adult female pyriform, pale ferruginous, exuviae pale reddish.—Australia on Banksia.-----*banksiae* Mask.
- cc. Pygidium with each group of pregenacerores consisting of about eight to ten genacerores.
  - d. Pygidium of adult female with lobes broadly truncate at distal end with notch on lateral margin; lobes far apart and incisurae filled with broad distapectinae; altaceratubae 7, one mesal and three on each side; mesospiracerores none; anus located midway between vulva and caudal margin; genacerores 3-4 (7-13)7-10.—Bohemia on Abies.-----*parlatoriae* Sulc.
  - dd. Pygidium of adult female with lobes subtriangular, mesal margins straight, median pair of lobes largest, with one mesal and two lateral notches; second pair of lobes with distal end rounded, with two lateral notches; third pair of lobes similar to second but smaller; fourth pair of lobes sometimes represented by crenate projection; incisurae strongly chitinated; pectinae subequal in length to lobes, narrow, of usual number, unapectinae; genacerores 1-2 (10-14) 9-14. Pygidium as figured is distinctly of aspidiotid type.—Society Islands on orange. -----*cinerca* Doane & Hadden.
- aa. Pygidium with four groups of genacerores.
  - b. Pygidium with four pairs of lobes.
    - c. Scale of adult female elongate, pyriform, distinctly longer than broad, whitish to yellow brown, exuviae dark; lobes with median, second, and third pairs with lateral and mesal notches; fourth pair of lobes narrow, elongate, bluntly pointed, unnotched; anus located a little caudad of vulva; genacerores (9-14)8-12.—Australia on Myrtus, Viburnum.-----*myrtus* Mask.
  - cc. Scale of adult female variable, usually circular, sometimes elongate or pyriform.
    - d. Pygidium of adult female with genacerores (6-10)6-9.
      - e. Scale of adult female dusky whitish tinged with brownish, exuviae yellowish; median, second, and third pairs

- of lobes with mesal and lateral notches; fourth pair of lobes variable in size and form, always shorter than third, subequal in width, usually pointed or tridentate; distapectinae broad and filling incisurae.—District of Columbia, Florida, Louisiana, Ohio, Kansas, California, Mexico, Hawaiian Islands, Japan, Europe, Algeria, Ceylon on Japonica, lemon, orange. -----*pergandei* Comst.
- ee. Scale of adult female with secretory portion pale transparent ochreous and exuviae bright castaneous or brownish orange with broad black mesal band; pygidium as in typical specimens.—Ceylon on *Phyllanthus*.-----  
*pergandei phyllanthi* Green.
- dd. Pygidium of adult female with genacerores (6-6)5-5; scale pale to dark slate color, exuviae yellowish; median, second, and third pairs of lobes narrow, bluntly rounded, with mesal and lateral notches; fourth pair of lobes minute, similar in general form to third, distinctly pointed, notched; distapectinae subequal in length with lobes, filling incisurae.—Philippine Islands on *Cocus*.-----*greeni* Banks.
- bb. Pygidium with three pairs of lobes.
- c. Pygidium with four distinct groups of genacerores.
- d. Pygidium with third pair of lobes not notched.
- e. Pygidium with the median and second pair of lobes of adult female faintly notched, third pair with distal end rounded, sides subparallel; pectinae of unapectina type; scale of adult female elongate, very wide, slate-gray, exuviae dark brown.—West Australia on *Petrophila*, *Hakea*. -----*petrophilae* Fuller.
- ee. Pygidium with all three pairs of lobes of adult female obliquely truncate, mesal margin longer than lateral, entire; fourth pair of lobes represented by broadly rounded area; pectinae narrow, hardly as long as lobes, finely toothed; scale of adult female pale yellow or brownish, exuviae yellow; mesospiracerores 2, metaspiracerores wanting; genacerores (10-14)9-14; anus located nearer transverse line drawn midway between vulva and caudal margin than vulva; altaceratuba 19, one mesal and nine on each side.—Ceylon on *Flacourtia*, *Scolopia*.-----  
*cingala* Green.
- dd. Pygidium with all lobes notched.
- e. Pygidium with each group of pregenacerores consisting of about twenty cerores; scale circular or ovate, brownish, exuviae brownish or greenish; genacerores (21-23)12-18.—Japan on *Euonymus*.-----*thea euonymi* Ckll.
- ee. Pygidium with each group of pregenacerores consisting of fifteen cerores or less.
- f. Pygidium of adult female with median pair of lobes elongate, pointed, mesal and lateral margins crenulate;

second pair of lobes broader and longer than first pair, distal end bluntly rounded, mesal and lateral margins crenulate; third pair of lobes smaller with mesal and lateral notches; pectinae slightly longer than lobes, those of median incisura approaching latapectinae in form, others distapectinae; genacerores (4-4)7-7.—Borneo on Gnetum. -----*hastata* Lindgr.

- ff. Pygidium of adult female with median pair of lobes as broad as or broader than second pair, their distal ends broadly rounded, never pointed.
- g. Scale of adult female circular or oval, never twice as long as wide.
- h. Scale of adult female pinkish-grey and finely punctate, exuviae dark brown to blackish brown; genacerores (10-11)10-11.—Australia on *Dryandra*. -----*dryandrae* Fuller.
- hh. Scale of adult female orange-yellow, sometimes tinged with green, exuviae yellowish, darker than excretory portion; lobes comparatively narrow, subconical, bluntly pointed, with more or less distinct mesal and lateral notches; pectinae broad and deeply toothed; altaceratubae 19, one mesal and nine on each side; anus located midway between vulva and caudal margin; spiracerores wanting; genacerores (5-7)4-7.—North America, South America, Europe, northern Africa, Australia, Japan, China, Ceylon, Hawaiian Islands on *Selenipedium*, *Vanda*, *Macrosamia*, *Pinus*, *Myrtes*, *Citrus*, *Camellia*, *Cymbidium*, *Pyrus*, apple, date-palm. -----*proteus* Curtis.
- gg. Scale of adult female elongate with subparallel sides, more than twice as long as wide, brownish fulvous, exuviae yellow; lobes comparatively narrow, distant, distal end bluntly pointed, with mesal and lateral notches; fourth pair of lobes sometimes represented by rudiment; pectinae of median, second, and third incisurae narrow, others wide; spiracerores wanting; genacerores (6-6)5-5; brevaceratubae numerous; altaceratubae distinct, one mesal and nine on each side; anus located midway between vulva and caudal margin.—Ceylon on *Psychotria*.-----*mytilaspiformis* Green.
- cc. Pygidium apparently with only two groups of genacerores, pregenacerores and postgenacerores forming continuous group on each side, limits indicated by constrictions near middle; scale of adult female elongate, ovate, rounded behind, whitish to brown, first exuvia brown, second exuvia veridical green; lobes with distinct mesal and lateral notches, constricted at proximal end; pectinae narrow; genacerores 23-26.—West Australia on *Pittosporum*. -----*viridis* Fuller.

## SPECIES OF PARLATORIA

- a. Pygidium of adult female with four pairs of lobes, first, second, and third pairs with mesal and lateral notches.
- b. Scale of adult female and both exuviae black; pygidium of adult female with lobes distant, median, second, and third pairs bluntly rounded, with mesal and lateral notches; fourth pair of lobes small, bluntly rounded, entire; distapectinae broad, not truncate, approaching latapectinae in form; anus and vulva located near line drawn between pregenacerores and postgenacerores; altaceratubae about 17, one mesal and eight on each side; genacerores (6-7)7-10.—United States, Europe, Australia, Algeria, China on *Zizyphus*, date-palm, orange, lemon.-----*zizyphi* Lucas.
- bb. Scale of adult female and both exuviae light colored, exuviae yellowish, never black; pygidium of adult female with lobes distant, the median, second, and third pairs typical in form; fourth pair of lobes small, short, bluntly rounded, entire; distapectinae broad, truncate, not approaching latapectinae in form; genacerores (8-11)9-13.—*Cryptoparlatoria parlatoresoides* Lindgr.—India on *Xanthophyllum*.-----*parlatoresoides* Lindgr.
- aa. Pygidium of adult female with three pairs of lobes; exuviae of scale of adult female pale, never black.
- b. Pygidium of adult female with median and second pair of lobes distinctly notched.
- c. Pygidium of adult female with sides of lobes parallel or convergent distad, never convergent proximad or constricted; lobes broader than long, margins serrate; pectinae long and narrow, slightly longer than lobes, distal ends obscurely toothed, arranged 2, 2, 2, 2 or 3, those of each lateris adjacent to lobe; altaceratubae obscure, three on each side; anus central in position; spiracerores wanting; genacerores (6-6)4-4; scale pale yellow, second exuvia almost covering scale, fringed with narrow area of whitish wax.—*Cryptoparlatoria atalantiae* Green.—Ceylon on *Atalantia*.-----*atalantiae* Green.
- cc. Pygidium of adult female with sides of lobes not parallel, convergent at least proximad and sometimes distad, always constricted.
- d. Pygidium of adult female with lobes constricted on proximal half, pointed at distal end with one mesal and two lateral notches, distant; fourth pair of lobes sometimes fully developed; pectinae long and narrow, subequal in length to lobes, not filling incisurae, finely toothed, altaceratubae 7, one mesal and three on each side; brevaceratubae few in number or wanting; spiracerores wanting; genacerores (4-5)5-6.—*Cryptoparlatoria aonidiformis* Green.—Ceylon on *Nothopegia*.-----*aonidiformis* Green.
- dd. Pygidium of adult female with lobes distinctly constricted on proximal portion and with distal portion rounded with mesal and lateral notches; pectinae broad, distinctly longer than lobes, deeply toothed; altaceratubae 13, one mesal and six on each side; brevaceratubae numerous; genacerores

(13-16)11-13; scale of adult female dark greenish-gray, sometimes almost black.—Australia on *Pittosporum*.-----

*pittospori* Mask.

- bb. Pygidium of adult female with median and second pair of lobes constricted at proximal and broadly truncately rounded without notches at distal end, entire; third pair of lobes with single lateral notch; pectinae broad, not truncate, irregularly toothed; genacerores (6-10)3-8.—Australia, northern Africa, Arizona on date-palm. -----*blanchardi* Targ.

SPECIES OF CRYPTOPARLATORIA

- a. Pygidium of adult female with three pairs of lobes.
- b. Pygidium of adult female with two plates between median pair of lobes and two plates in each second and third incisura; plates thorn-like and three or four times as long as lobes; with three pairs of short, conical, pointed, colorless lobes; each incisura with latadentis bearing oraceratuba; genacerores (9-11)7-11; mesospiracerores 3-4; pygidium of second nymphal female with three pairs of lobes and with narrow distapectinae.—Japan on *Juniperus*, *Chamaecyparis*. -----*leucaspis* Lindgr.
- bb. Pygidium of adult female with single plate between median pair of lobes and two in each second and third incisura and three subadjacent plates on each lateris near each third lobe; plates longer than lobes, sides parallel, distal fourth nipple-like constricted portion; with three pairs of lobes, one-half or more length of plates, pointed, each with lateral notch; latadentes wanting between lobes; genacerores (6-6)4-4; mesospiracerores 1; pygidium of second nymphal female with three pairs of broad lobes with lateral and mesal notches; each incisura with two broad distapectinae and several on each lateris.—Celebes, Philippine Islands on *Artocarpus*, *Mallotus*.-----*uberifera* Lindgr.
- aa. Pygidium of adult female with two pairs of lobes.
- b. Pygidium of adult female with furcapectinae in median incisura; with two pairs of lobes, median pair largest, with faint mesal and lateral notches; second pair of lobes with lateral notch only; furcapectinae subequal in length to lobes, arranged, 2, 2, 9, those of each lateris arranged 3-2-2-2; lateres deeply crenulate; genacerores (10-12)10-12; scale elongate oval, formed of large dark brown second exuvia and white excretory portion forming rim in front and lance-shaped projection behind.—Parlatoria destructor Newst. MSS.—Australia on apple.-----*destructor* Frogg.
- bb. Pygidium without furcapectinae or plates in median incisura.
- c. Pygidium of adult female with median lobes subadjacent, deeply notched on lateral margin and rounded unnotched on mesal; second pair of lobes long and narrow, bluntly pointed, deeply notched on lateral margin; third pair of lobes faintly indicated; plates arranged, 0, 2, 2, 5, those of each incisura small and serrate; lateres long and without latadentes; altaceratubae 13, one mesal and six on each side; anus located on cephalic side of line drawn midway between vulva and caudal

margin and nearer line than vulva; genacerores 1-4(8-10)8-12.  
—*Parlatoria pyri* Marl.—China on apple, pear.-----*pyri* Marl.

- cc. Pygidium of adult female with median pair of lobes subadjacent, crenulate with fine notches on oblique lateral margin and obscure notch on mesal margin; second pair of lobes small, lateral margin with two to three faint notches; third pair of lobes not indicated; plates arranged, 0, 2, 2, 3, those of incisurae small; lateres long without latadentes; anus located slightly cephalad of vulva; altaceratubae about 12, six on each side, mesal wanting; genacerores (5-6)6-6.—*Parlatoria chinensis* Marl.—China, Japan on crab-apple, Hibiscus, Xanthoxylon, Thuja. -----*chinensis* Marl.

#### SPECIES OF LINDINGERIA

Pygidium of adult female with three pairs of lobes; median pair of lobes large, as broad as long, broadly rounded, entire; second and third pairs of lobes similar, slightly smaller, entire; plates truncate, subequal in length to lobes, arranged, 0, 2, 2, 3, those of each lateris arranged 2-1; setae large, longer than lobes; scale dark colored, reddish, genacerores in two groups of 4-6 cerores each; second nymphal female with two pairs of narrow rounded lobes with mesal and lateral notches; pectinae longer than lobes, with single short tooth on each side, arranged 2, 2, 6, those of each lateris arranged 2-2-2; lamaceratubae apparently present, also in first nymphal stage.—*Gymnaspis aberemoae* Lindgr.—Brazil on *Aberemoa*.-----*aberemoae* Lindgr.

#### SPECIES OF POROGMYMNASPIS

- a. Body of adult female subcircular in outline, lateral portions of metathorax not produced; scale of adult female consisting of naked bright red or reddish second exuvia, broadly oval, highly convex; pygidium of second nymphal female sharply defined, suberect in position; eight prominent slender lobes; median and second pairs obscurely notched; third pair of lobes obscurely indented on distal end; pectinae broad, three teeth; altaceratubae three on each side; pygidium of adult female truncate, bearing close fringe of tricuspid processes, four to six more strongly chitinized, similar in form to other processes, if lobes, other projections arranged 2, 2, 3, 2; anus seven times its width from caudal margin and one and one-half times caudad of vulva; genacerores 1-5(10-15)11-17.—North Australia on *Pandanus*. -----*rufa* Green.
- aa. Body of adult female with lateral portions of metathorax produced on each side into rounded projection bearing minute conical points; scale of adult female consisting of naked second exuvia with or without first exuvia, yellow or orange with broad transverse blackish fascia; pygidium of second nymphal female with three pairs of slender lobes, constricted on proximal portion, distal portion sharply pointed; pectinae truncate, arranged 2, 2, 3, 3; each lateris with seven triangular lobe-like projections, as long as pectinae; altaceratubae three on each side; pygidium of adult female with six minute broadly triangular projections or lobes and fringe of tricuspid processes, each attenuate, arranged 2, 2, 3, 3; each lateris with three triangular projections; anus about six

times its width from caudal margin and about once caudad of vulva; genacerores 8-9 (9-12), sometimes arranged in two groups or connected by a series of three or four isolated cercores.—North Australia on Pandanus.-----*angulata* Green.

SPECIES OF GENAPARLATORIA

- a. Pygidium of adult female with five pairs of lobes.
  - b. Pygidium of adult female with median pair of lobes broad and deeply notched on lateral and mesal margins; second pair of lobes much smaller, sides parallel, and deeply notched on lateral margin; third pair of lobes subequal in size to second and faintly notched on lateral margin; fourth and fifth pairs of lobes angular and pointed; pectinae distinct, narrow in median, second, and third incisurae and subequal in length to lobes, cephalic pectinae divided on sides, of unapectina-type, arranged 2, 2, 3, 3, 4, 4; dorsum with numerous breviceratubae; altaceratubae 8, nine on each side, mesal wanting; anus distant from vulva, caudad of middle, much nearer middle of distance between vulva and caudal margin than caudal margin; mesospiracerores and metaspiracerores 8-10.—*Parlatoria mangiferae* Marl.—China, District of Columbia on Mango.-----*mangiferae* Marl.
  - bb. Pygidium of adult female with median pair of lobes broad, notched on mesal and lateral margins; second and third pair of lobes with parallel sides, mesal margin entire, lateral margin notched; fourth and fifth pairs of lobes pointed, broadly triangular; pectinae of median, second, and third incisurae longer than lobes, toothed only at end, those of fourth and fifth incisurae broad, toothed also on side, bluntly pointed, arranged, 2, 2, 3, 4, 5; mesospiracerores 10.—*Parlatoria pseudaspidiotus* Lindgr.—Singapore on Vanda.-----*pseudaspidiotus* Lindgr.
- aa. Pygidium of adult female with two pairs of entire lobes, first pair largest, broadly and bluntly rounded, second pair bluntly pointed; distapectinae broad, filling incisurae, their distal ends irregularly toothed, some approximating latapectinae; mesospiracerores 0-2.—*Persea* on *Ephedra*.-----*ephedrae* Lindgr.

SPECIES OF GYMNASPIS

- a. Pygidium of adult female always with true lobes, never with pseudolobes or without lobes.
  - b. Pygidium of adult female with distinct pectinae.
    - c. Pygidium of adult female with three pairs of lobes; median pair of lobes short and broad with lateral and mesal notches; second pair of lobes short and oblique with prominent lateral notch; third pair of lobes rudimentary with lateral notch; pectinae of median incisura subequal in length to lobes, furcapectinae, others unapectinae, longer than lobes, teeth short; pectinae arranged 2, 2, 3, 3, those of each lateris near third lobe; anus near caudal margin; scale dull crimson in color.—This species has habitus of aspidiotid.—Uganda on unknown shrub.-----*africana* Newst.
  - cc. Pygidium of adult female with two pairs of lobes, lobes nar-



row with subparallel sides and distinct mesal and lateral notches; unapectinae with teeth much longer than stem of pectina, arranged 2, 2, 8, those of each lateris approximating plates in form and spread over entire margin; margin of segments of preabdomen with furcapentinae-like projections; anus near middle and superimposed above vulva; scale bright yellow, minute, circular, convex.—India on *Mesua*.-----  
*spinomarginata* Green.

- bb. Pygidium of adult female without pectinae or plates.
- c. Pygidium of adult female with two pairs of lobes.
  - d. Pygidium of adult female with median pair of lobes large, oblique, mesal margins deeply serrate, placed in pygidial incision; second pair of lobes slender, rounded, rudimentary projections; setae of median incision large; pygidium of second nymphal female similar, with prominent altaceratubae; second exuvia covering nearly entire scale, naked, shining black, margined by thin white scale.—*Paralatoria distinctissima* Newst.—*Aonidia distinctissima* Newst.—India on *Nerium*.-----*distinctissima* Newst.
  - dd. Pygidium of adult female small with two large clubbed terminal lobes with fine pointed projections on either side of lobes, forming irregular fringe; with four irregular depressed areas close to outer margin on either side of terminal lobes; body almost circular, dull yellowish and finely striate on abdominal segments; scale reddish brown, convex, sometimes covered with thin incrustation of white secretion.—The figure of scale is that of aspidiotid.—New South Wales on *Acacia*.-----*acaciae* Frogg.
- cc. Pygidium of adult female with four pairs of lobes arranged in transverse row across end of truncated pygidium; lobes small, subequal, entire, broader than long, distance between median lobes twice width of lobe; plates and pectinae wanting, with pair of short pointed projections in each incisura, sometimes toothed like pectinae; pygidium of second nymphal female with pygidial margin more convex than that of adult female, with numerous pseudolobes; pygidium of first nymph with five pairs of lobes with unapectinae between them and with prominent altaceratubae; median incisura narrower than any of others; scale black, cephalic half globular, broader and larger than caudal portion.—*Aonidia bullata* Green.—Ceylon on leaves of unidentified tree.-----*bullata* Green.
- aa. Pygidium of adult female always without true lobes, either with pseudolobes or entire and without lobes.
  - b. Pygidium of adult female entire, always without projections or pseudolobes; pygidium of second nymphal female with three pairs of narrow, bluntly rounded, entire lobes; pectinae wanting in median incisura, median lobes adjacent; each second and third incisura with two distapectinae and seven or more on each lateris; scale reddish and subhemispherical.—West Australia on *Hakea*.---  
*perpusilla* Mask.

- bb. Pygidium of adult female always with numerous pseudolobes, never entire.
- c. Pygidium of adult female with comparatively broad, bluntly rounded, crenulate pseudolobes, many of them broader than long; pygidium of second nymphal female with four pairs of lobes, median, second, and third pairs bluntly rounded with mesal and lateral notches, fourth pair subtriangular with lateral notch; unapectinae subequal in length to lobes, arranged 2, 2, 2, 3, 3, those of each lateris near lobe; scale semicircular, strongly convex, exuviae large, reddish in color.—*Aonidia ebeni* Leon.—*Aonidia crenulate* Green.—Ceylon on *Diospyros*, *Memecylon*. -----*crenulata* Green.
- cc. Pygidium of adult female with long, slender, plate-like pseudolobes, twice or more as long as wide, never with their margins crenulate; anus distant from caudal margin, superimposed over vulva; pygidium of first nymphal female with two pairs of lobes, median pair rounded, with lateral and mesal notches; second pair smaller, bluntly rounded, entire or with mesal notch; two short distapectinae in median incisura, one in second, and two just beyond each second lobe; scale of adult female consisting entirely of second exuvia, strongly convex, black.—England, Brazil on *Aechmea*.-----*aechmeae* Newst.

## CHAPTER XXIII

### TRIBE LEUCASPIDINI

#### *The White-shield Scales*

The body of the adult female is usually longer than broad with the cephalic and caudal ends bluntly rounded and with the lateral margins distinct and slightly convex. The lateral margins of the segments of the preabdomen are never provided with bracteae either in the adult or second nymphal female. Lobes are present in the second nymphal female, frequently represented by pseudolobes in adult female. There are usually two, three, or four pairs of lobes, sometimes unusual in form and approaching pseudolobes, if wanting, present in the second nymphal female. Distapectinae are rarely present in the adult female, frequently with furcapectinae, they may be present and typical in form in second nymphal female. Plates frequently present in adult female, very long with sides converging distad. Incisurae are broad and shallow, usually filled with pectinae or plates. Densariae and paraphyses are never present. Altaceratubae are present and usually large, if wanting in adult female, present in second nymphal female. Brevaceratubae are usually present, but not numerous and not arranged in rows. Genacerores are usually present, five groups are generally represented, there may be three or a single large group or there may be additional groups, even as many as twelve. Mesogenacerores are usually present, when they can be recognized as a separate group, usually consist of less than eight cerores. Scale of adult female is elongate, may be four or more times as long as broad, pyriform, or with the sides parallel or subparallel. Exuviae are usually represented by the first exuvia in the adult female and attached to the end of the scale. Adult female always enclosed in a puparium, the puparium large, nearly as long as the scale. Scale of male is elongate, subpyriform or with the sides parallel, convex, white in color, with exuvia at one end, and never carinate.

The tribe Leucaspidini in common with the other tribes of Diaspidinae, except the Fioriniini, was first recognized as a separate subdivision by Leonardi in 1897 under the name of Leucaspides. A year later he gave an analytical table for the separation of the five tribes. In this table the genus Fiorinia, the type of the tribe Fioriniini, is combined with the Mytilaspides. A synopsis of the species of Leucaspides was published in 1906 by Leonardi. In this publication the genus Leucaspis and two new genera, Anamaspis and Actenaspis, are recognized.

In all the species of the genus *Leucaspis*, so far as known, the adult female completes its existence in a puparium. This method of development is considered as a mark of the highest type of specialization. The lines of modification of the pygidium after the assumption of this method of development is apparently the same in most of the tribes. One change usually to be noted is a modification and reduction of the groups of genacerores until they are finally completely suppressed. An exception to this rule is found in most of the species of this tribe. Although transforming in a puparium, they have not only retained their genacerores, but they are frequently represented by groups containing a considerable number of cerores. There may be the typical number of groups, five, present or there may be additional groups present until as many as seven additional groups can be counted or the five groups may be combined into a single large inverted U-shaped or crescentic mass or omnagenaceroris.

The pygidial fringe of this tribe illustrates well some of the stages in the modification of lobes and pectinae. The lobes are modified not only in size and changed in shape, but are lost in the adult females of certain species. The pectinae, which are typically distapectinae in the second nymphal females, are greatly elongated in the adult female of many species. They are slender in form with converging sides with blunt ends. These vary in form from coarsely toothed to finely toothed, to the lack of teeth, and eventually assume the form of plates. The number of plates is greatly reduced in certain species while in other species the pygidium appears with projections, pseudolobes, which are asymmetrical not only in form but in arrangement. Some of the pseudolobes resemble lobes and others pectinae or plates. The pygidium of *indica* is of particular interest as illustrating an intermediate stage of modification. The genacerores are wanting. The lobes, of which there are three distinct pairs, have been modified into greatly elongated clavate structures. The projections between the lobes are broad structures with their distal ends blunt without teeth. That these are pectinae or plates undergoing modification is shown by their number and arrangement, 2, 2, 3, 3, which is typical for the second nymphal stage of *loewi* as figured by Newstead and of the large majority of generalized pygidia of other tribes. The position of the lobes and the number of projections, pectinae or plates, between them is more dominant than the form of these structures although the dominance of the form of the lobes is generally more marked

than that of the projections between them. The descriptions and figures of certain species would suggest that this tribe contained species transforming in a puparium that had not only retained their genacerores but that their pygidia were provided with typical lobes and pectinae or plates. Many writers content themselves with studying only the pygidium of the adult female and it is not impossible that some have figured and described the pygidium of the second nymphal female as that of the adult. This may account for the presence of primary lobes and pectinae in the pygidium of certain adult females or it may be that the primary lobes and pectinae have not been lost. *Lindinger and Green figure and describe the pygidium not only of the adult female but also of the second nymphal female. The structure of the pygidium of this latter stage is more useful in determining the tribal location and the specific limits of those species transforming in puparia than the pygidium of the adult female.*

The common name of The White-shield Scales is derived from the name of the typical genus, *Leucaspis*, which is derived from the Greek words meaning white and shield. The scale of the adult female is generally light in color, often snowy white. They are always greatly elongated with the single exuvia, the first nymphal, at one end. This exuvia bears the remains of the antennae as porrect structures. The scales vary in outline from those with parallel sides to those that are pyriform. The puparium or second exuvia is large, occupying the greater part of the scale so that there is only a narrow thin peripheral area of excretion or wax, which may extend as projections beyond the first exuvia and beyond the caudal end as described for *cockerelli* by Green. The scale of the male is usually smaller, but similar in form with a single exuvia. It is white in color, but never longitudinally carinate as in the white male scales of many *Diaspidini*.

The body of the adult female is greatly elongated, and resembles superficially many species of *Lepidosaphes*. The two ends are bluntly rounded or subtruncated, and the sides vary from subparallel to slightly convex. The segmentation of the thorax and abdomen is fairly distinct. The spiracerores are usually distinct and, when they have been more carefully examined and reported upon, may be found of considerable value in the separation of species. The mesospiracerores are generally present and consist of three to twelve cerores, while the metaspiracerores are frequently wanting. Authors in describing the spiracerores usually do not mention the metaspiracerores when they are want-

ing. When present they are few in number, rarely with more than three or four cerores. The pygidium is comparatively small, not only in the second nymphal females but also in the adult female. The altaceratubae may be distinct in some adult females, but so far as noted, are always present in the second nymphal females. When the pygidia have been more carefully and extensively studied, they will probably be found characteristic of the pygidia of all the females of the second nymphal stage. The number of altaceratubae varies greatly and they are apparently completely wanting in some adult females. The typical number of lobes is difficult to determine, because in most species they are not typical in form, but are greatly reduced and lack their characteristic notches and are greatly elongated. There are usually two or three pairs present. In the adult female the projections between the lobes are usually greatly elongated, plate-like in general form, but frequently with a few teeth at the distal end or in the form of furcapectinae. Even when the lobes and pectinae or plates are greatly modified in form, they are quite constant in number, usually arranged 2, 2, 3, 3.

The genacerores are more frequently present than wanting and usually consist of five groups. What is considered as the primitive type is an arrangement into five groups, such as is found in bambusae of Kuwana. This pygidium is generalized in many ways, so as to suggest that the fringe, if it were not that genacerores are present, that it must be that of the second nymphal female. In stricta, according to Maskell, there are three groups, the mesogenacerores and pregenacerores form a continuous single large crescentic group, with the two groups of postgenacerores distinctly separated from each other and the cephalic group. There is in pini as figured by Signoret only a single large undivided crescentic group, although Leonardi states that there are five groups which are more or less distinct among themselves and arranged in the arc of a circle about the vulva. In cordylinidis there is a single undivided group of about one hundred cerores. The pygidium of signoreti shows a very different type, here the groups of genacerores as figured by Signoret are subdivided into several secondary groups. These groups are arranged in two transverse rows. The cephalic row contains five subgroups and the caudal row seven groups of which each lateral group contains only about three cerores, making twelve groups in all. It is not possible to homologize among these twelve groups, the mesogenacerores, the pregenacerores, and the postgenacerores.

Since the adult females of all the species of this tribe are enclosed in a puparium, it should be a simple matter to study the pygidium of the second stage female which is that borne by the puparium. Such a study was made by Lindinger and the results published in 1906. He figures in this paper and describes the pygidium of the first and second nymphal stages and from one to three types of that of the adult female. Nine species are recognized and figured in this way and it is to be hoped that the other species may soon receive a similar treatment.

Leonardi in his revision published in 1906, as already noted, subdivides the tribe into three genera, *Leucaspis* of which *pini* Hartig is the type, *Anamaspis* of which *loewi* Colvée is the type, and *Actinaspis* of which *pusilla* Loew is the type. The last two of these genera he named as new and each includes only its type species. The differentiation of these genera was not well made. These names although stated to be subgenera in his analytical table are designated as genera elsewhere. The following is a translation of the table by Leonardi:—

GENERA OF LEUCASPIDINI

- a. Pygidium provided with pectinae.
  - b. Pygidium with lobes.-----*Leucaspis* Targ.
  - bb. Pygidium without lobes.-----*Anamaspis* Leon.
- aa. Pygidium without pectinae. -----*Actinaspis* Leon.

Lindinger in his synopsis recognizes eleven of the twenty described species referred to the genus *Leucaspis*, of which he figures and describes nine. Four of the species previously referred to this genus he places in the genus *Lepidosaphes* and the remaining ten are referred to the synonymy or considered as unrecognizable. The classification of Leonardi is discarded as untenable and the genus is divided into two named sections, *Salicicola* and *Euleucaspis*, which must of necessity be recognized as subgenera. *Salicicola* includes the single species *kermanensis* Lindgr., which is the type. The pygidium of the adult female of this species is very similar to that of *loewi* Colvée, the *sulci* Newst. of Lindinger. The remaining eight species are included in *Euleucaspis*, for which *pini* Hartig may be taken as the type. The section *Euleucaspis* is divided into two other named groups, *Pusillaspis* and *Suturaspis*, which should also of necessity be considered as subgenera. *Pusillaspis* includes two species, *pusilla* Loew, which may be taken as the type, and *sulci* Newst. *Suturaspis* includes the remaining six species, of which *pistaceae* Lindgr.

may be taken as the type. The following is a translation of the tables of Lindinger:—

SECTIONS OF LEUCASPIS

- a. Scale elongate, widened in front and not behind. Pygidium of first and second nymphal females with comb-like toothed plates, distinctly separated from lobes. ----- *Euleucaspis* Lindgr.
- aa. Scale elliptical or oval. Pygidium of first and second nymphal females with lobes and plates formed like lobes. .... *Salicicola* Lindgr.

SUBDIVISIONS OF EULEUCASPIS

- a. First nymph with deep constriction between prothorax and mesothorax. Scale gradually widened. .... *Suturaspis* Lindgr.
- aa. First nymph not with deep constriction. Scale suddenly widened. *Pusillaspis* Lindgr.

The following tentative tables include most of the described species. They are based for the most part upon the characters used by previous authors in describing and differentiating species. The tables will aid in the identification of the various genera and species. Attention has already been called to the necessity for careful extended studies of the pygidium of the second nymphal female. Such studies are also needed to determine whether the lobes of the adult female are not frequently true lobes, as their size, form, and arrangement would suggest. This conclusion is confirmed by the characteristic number of the projections, 2, 2, 3, 3, between these so called primary lobes.

GENERA OF LEUCASPIDINI

- a. Pygidium of adult female with groups of genaceroroes.
- b. Pygidium of first and second nymphal female with lobes.
- c. Pygidium of adult female with lobes, never with pseudolobes.
- d. Pygidium of adult female with lobes and distinct pectinae or plates; pygidium of first and second nymphal females with lobes and distapectinae; first nymph, so far as known, with mesocoria forming distinct constriction. .... *Leucaspis* Targ.
- dd. Pygidium of adult female without lobes, at most only with lobe-like projections; pygidium of second nymphal female with distapectinae; first nymph with mesocoria not forming distinct constriction. .... *Anamaspis* Leon.
- cc. Pygidium of adult female without lobes, pectinae, or plates, but always with pseudolobes; first nymph with mesocoria not forming distinct constriction. .... *Actenaspis* Leon.
- bb. Pygidium of first and second nymphal females with lobes, without pectinae, plates represented by lobe-like projections; first nymph with mesocoria not forming distinct constriction. .... *Salicicola* Lindgr.



- aa. Pygidium of adult female without groups of genacerores.-----  
-----*Suturaspis* Lindgr.

## SPECIES OF LEUCASPIS

- a. Pygidium of adult female with five or less groups of genacerores.
- b. Pygidium of adult female with five distinct groups of genacerores.
- c. Pygidium of adult female with two pairs of lobes; the median pair of lobes short and broad with distinct lateral and mesal notches; second pair of lobes broad, incised, each lobelet with lateral and mesal notches; distapectinae short and broad, not as long as lobes, arranged 2, 1, 3; setae long and prominent, much longer than lobes; altaceratubae and brevaceratubae present; anus located on line drawn through pregnacerores and vulva on line between pregenacerores and postgenacerores; genacerores 5-5(9-11)7-9; scale of adult female snowy-white with parallel sides.—Japan on bamboo.-----*bambusae* Knw.
- cc. Pygidium of adult female with three pairs of lobes; lobes about as broad as long, entire, bluntly rounded; plates short, stout, triangular, arranged 2, 2, 3, 3-4; mesospiracerores about 10; genacerores in five groups, three cephalic groups sometimes contiguous, forming single group, 19-19(27-32)19-23; caudal margin with 8 symmetrically placed large setae; second nymphal female with two pairs of lobes, broad, deep lateral and mesal notches; distapectinae broad.—*Fiorinia gigas* Mask., *Fiorinia morrissi* (Brittin) Green.—New Zealand on *Astelia*, *Atherosperma*, *Coprosoma*, *Pittosporum*.-----*gigas* Mask.
- bb. Pygidium with less than five groups of genacerores.
- c. Pygidium of adult female with three groups of genacerores, mesogenacerores and pregenacerores combined into single crescentic group, sometimes in five groups, 9-9(15-22)10-14; pygidium with margin fringed with long slender furcapectinae, much longer than two pairs of short, blunt, unnotched lobes; mesospiracerores 10; vulva located between postgenacerores and anus located at about same distance from caudal margin. *Fiorinia stricta* Mask.—New Zealand on *Dendrobium*, *Hedycarpus*, *Phormium*, *Cordylina*, *Astelia*, *Hoheria*.-----*stricta* Mask.
- cc. Pygidium of adult female with single large horse-shoe-shaped group of genacerores, 200 cerores, apparently formed by combination of all five groups; pygidial margin with broad mesal series of thickened, short, sublobe-like projections; on each side cephalad of this thickened area margin of pygidium to line drawn through caudal margin of genacerores, bearing short, sharp, triangular, plate-like projections, much longer than projections of thickened area; anus and vulva at about same level, near transverse line drawn through caudal ends of genacerores.—Australia on *Cordylina*.-----*cordylinidis* Mask.
- aa. Pygidium of adult female with more than five groups of genacerores.
- b. Pygidium of adult female with three pairs of lobes.
- c. Mesospiracerores 9-11, metaspiracerores 2-3; pygidium of adult

female with three pairs of minute, pointed, triangular lobes; pectinae and plates numerous, extending around pygidial margin, slender, bluntly pointed, at least twice as long as lobes; median and second incisurae each with two plates, each third incisura with 3-5; genacerores in nine groups, five primary groups when identifiable 13-13(16-17)10-12; four groups in two transverse rows cephalad of mesogenacerores, consisting of 3-4 and 2-3 cerores; anus superimposed over mesogenacerores and vulva located between postgenacerores.—*Leucaspis candida* Targ.—Europe on Pinus. -----*pini* Hartig.

- cc. Mesospiracerores 12, metaspiracerores 0-1; pygidium with three pairs of minute bluntly pointed lobes; pectinae wanting, plates long and slender, bluntly pointed, twice or more length of lobes; median incisura with two plates, second incisura with three, third incisura with six or seven; genacerores in about twelve groups arranged in two transverse curving rows; anus superimposed over pregenacerores and vulva on transverse line drawn through caudal part of postgenacerores.—*Leucaspis corsa* Lindgr.—Europe on Pinus.---*signoretti* Targ.

bb. Pygidium of adult female with two pairs of lobes.

- c. Pygidium of adult female with lobes obtusely rounded, all of them usually entire.
- d. Pygidium of adult female with median pair of lobes entire, obtusely pointed lobes and second pair of small reduced dentiform projections; plates simple, much longer than lobes; pygidium of second nymphal female with broad pectinae; genacerores arranged in nine groups, group of mesogenacerores much smaller than either of other groups, pregenacerores or postgenacerores, four extra groups, small, consisting of only a few cerores, two groups on each side cephalad of mesogenacerores; scale of adult female pure white, elongate, attenuate, first exuvia brownish.—Algeria on Ephedra. -----*ephedrac* Marchal.
- dd. Pygidium of adult female with lobes subequal in size and similar in form, second pair not or only slightly smaller than median, entire; median incisura with two distapectinae, second incisura with two or three pectinae-like projections, and three or four on each lateris adjacent to a lobe, pectinae with two to four coarse teeth; lobes two-thirds length of pectinae; mesospiracerores 5-6; genacerores arranged in single crescentic group of 47 cerores or in three groups, 7-9(29-29), and two small groups on each side cephalad of the mesogenacerores; scale of adult female white with blackish marginal glistening first exuvia.—*Leucaspis epidaurica* (Genn.) Lindgr.—France, Greece, Italy, Cyprus on Olea.-----*riccae* Targ.

- cc. Pygidium of adult female with lobes distinctly pointed, never obtusely rounded.

- d. Pygidium of adult female with median pair of lobes constricted on proximal portion.
- e. Exuvia of second nymphal female granulose; pygidium of adult female with median pair of lobes small, arrow-shaped, constricted on proximal portion, sharply pointed, entire; second pair of lobes shorter, triangular; pectinae longer than lobes, arranged 2, 2, 2-3, blunt, simple, plate-like projections cephalad of cephalic pectinae; mesospiracerores 4-5; anus located on transverse line drawn between three caudal groups of genacerores; genacerores 20-25(—)7-8 and a supplementary group, 3-4 cerores, on each side of two preceding segments; dorsal oracera-tubae numerous, irregularly arranged; two transverse series of irregularly quadrate or triangular thickened patches on caudal portion of pygidium; sinuous series of minute ventral conical points extending on each side from rostrum to pygidium; pygidium of second nymphal female with two pairs of notched lobes; pectinae dista-pectinae, arranged 2, 2, 3, also three bluntly rounded distant projections cephalad of pectinae.—Japan, California on broom, apple, maple, magnolia, Paeonia.—*japonica* Ckll.
- ee. Exuvia of second nymphal female more strongly granular; lobes more deeply cleft; body of adult female with ventral series of conical points more extended and pectinae more deeply fimbriate.—North Australia on Ficus.-----  
*japonica darwiniensis* Green.
- dd. Pygidium of adult female with median pair of lobes not constricted on proximal portion.
- e. Pygidium of adult female with two pairs of short, minute, triangular lobes; pectinae two or three times as long as lobes, sides subparallel, narrow, distal ends with five short teeth; mesospiracerores 3-4, metaspiracerores wanting; group of 16 cerores laterad of each mesospiracle; genacerores sometimes in five groups 11-11(15-15)11-11 and with two small groups of cerores on each side cephalad of mesogenacerores; anus located over mesogenacerores and vulva between postgenacerores; scale of adult female white.—France on pinus.-----*affinis* Leon.
- ee. Pygidium of adult female with two pairs of long, pointed, slender lobes with distinct mesal and lateral notches near middle of their length; pectinae deeply toothed at distal end, constricted on proximal portion, subequal in length to lobes, those of each lateris broader and not so deeply toothed, two in median and second incisurae, three cephalad of each second lobe and two to four broad toothed pectinae laterad of others, extending upon ventral surface near to and parallel with lateral margin of body to head; genacerores in five groups and two on each side cephalad of mesogenacerores; head with small stout thorn-like spine cephalad and laterad of each antenna; pygidium of second nymphal female with two

pairs of lobes with prominent mesal and lateral notches and with broad deeply toothed distapectinae in incisura and on each lateris; scale of adult female narrow, tapering to blunt point at each end, excretory portion limited, extending cephalad of first exuvia as blunt projection and knob-like constricted area at caudal end.—*Fiorinia cockerelli* Charmoy.—Mauritius, Ceylon on *Draecaena*, *Pritchardia*. ----- *cockerelli* Charmoy.

SPECIES OF ANAMASPIS

Pygidium of adult female with two pairs of small, short, rounded lobes and third pair frequently wanting and when present asymmetrically placed or all lobes not sharply defined; genacerores arranged in form of crescent, sometimes in five groups, arranged 5-10(10-14)9-13; mesospiracerores 2-5; anus placed over mesogenacerores and vulva between postgenacerores; pygidium of second nymphal female with two distapectinae in median incisura and in other incisurae.—*Fiorinia sulci* Newst.—Europe on *Pinus*.----- *locvi* Colvée.

SPECIES OF ACTENASPIS

Pygidium of adult female fringed with numerous long asymmetrically arranged projections or pseudolobes, distal ends frequently more or less dilated and finely toothed; genacerores arranged in shape of crescent, sometimes divisible into five groups, 9-9(10-11)6-10; mesospiracerores 0-7; pygidium of second nymphal female with two pairs of broad truncated lobes with deep mesal and lateral notches; median and second incisurae each with two distapectinae and four or more of each lateris adjacent to each second lobe; altaceratubae prominent, 9-11, one mesal and 4-5 on each side.—*Leucaspis leonardi* (Ckll.) Lindgr.—Europe, Canary Islands, Algeria, Syria on *Pinus*.----- *pusilla* Loew.

SPECIES OF SALICICOLA

Pygidium of adult female with lobes, plates or pectinae, sometimes with margin with slight irregular projections, these sometimes forming five pairs of lobe-like projections; genacerores in single crescentic group of 28 to 40 or in three distinct groups; mesospiracerores 2; pygidium of second nymphal female with two pairs of lobes, median pair broad, subtruncated, rounded, entire; second pair of lobes much smaller, triangular, bluntly pointed; median incisura without pectinae or plates, second incisurae and each lateris with two short, blunt, lobe-like projections or plates.—*Persia* on *Salix*.----- *kermanensis* Lindgr.

SPECIES OF SUTURASPIS

- a. Pygidium of adult female with three pairs of long spatulate bluntly rounded lobes, three or four times as long as broad; plates broad and blunt, about one-half as long as lobes, distal end rounded, arranged 2, 2, 3, 3.—*Leucaspis indica* Marl.—India on mango.----- *indica* Marl.
- aa. Pygidium of adult female never with long spatulate lobes.
  - b. Pygidium of adult female with two distant pectinae between median pair of lobes, median pair of lobes distant, rounded, with

slight lateral notch; second and third pairs of lobes successively smaller and each incised; second and third incisurae with pectinae and each lateris with prominent latadentes.—*Leucaspis kelloggi* Colem.—California on *Pseudotsuga*, *Abies*.-----

*kelloggi* Colem.

bb. Pygidium of adult female without pectinae or plates.

c. Pygidium of adult female with lateres entire, with single pair of broad, very short, rounded, lobe-like projections; second nymphal female with two pairs of distinct lobes with lateral and mesal notches; plates short and blunt, shorter than lobes, two in median incisura and one in each second incisura; mesogenacerores three or none, usually none; mesocoria of first nymph distinctly transversely constricted.—*Leucaspis pistaciae* Lindgr.—Cyprus on *Pistacia*.-----*pistaciae* Lindgr.

cc. Pygidium of adult female with lateres crenulate, not with distinct lobe-like projections; second nymphal female with two pairs of distinct lobes, broad and bluntly rounded, entire; pectinae broad, two in median incisura and two on each side of each second lobe; mesogenacerores wanting.—*Leucaspis indiae-orientalis* Lindgr.—India on *Pinus*.-----

*indiae-orientalis* Lindgr.

## CHAPTER XXIV

### TRIBE LEPIDOSAPHINI

#### *The Oyster-shell Scales*

The body of the adult female is always distinctly longer than broad with the cephalic and caudal ends bluntly rounded. The lateral margins are parallel or subparallel usually with distinct indentations marking the position of the sutures between the thoracic and abdominal segments. The lateral margins of the segments of the preabdomen are never provided with bractae either in the adult female or second nymphal female. Lobes are usually present in the adult female, usually three pairs, more or less than this number may be present. Plates are rarely if ever absent, pectinae are rarely present and are then only furcapectinae. Incisurae are narrow and the space is usually filled with plates. The median incisura is typically provided with plates, rarely without. Densariae are never present and paraphyses only rarely. Altaceratubae, are rarely, if ever absent, usually arranged in pairs, their oraceratubae oval in outline, often twice as long as broad. Brevaceratubae are usually present, frequently numerous, sometimes arranged in transverse rows. Genacerores are usually present, arranged in five, four, or two groups. The mesogenacerores, when present, usually consist of more than eight cerores. Scale of adult female is coriaceous or horny, usually brownish or blackish in color, sometimes white or pale, quite typical in form, usually much longer than broad, from two to five times, frequently shaped like an oyster-shell, one margin convex and the other concave with the surface transversely ridged, sometimes with sides straight and subparallel. One end is much smaller than the other, small end bearing two exuviae. The female sometimes transforms in a puparium and the pygidium of the adult female is provided with pseudolobes. The scale of the male is similar in form to that of the female, elongate in form, with a single exuvia at one end.

The tribe Lepidosaphini, as recognized by Leonardi in 1899, contained four genera, one of which was divided into two subgenera. This number was increased to eight in his monograph of the Mytilaspides published in 1903. In the following pages twenty-eight genera are recognized.

The scale of the adult female is quite constant in form, typically mussel-shaped or oyster-shell-shaped or pyriform in general appearance. In certain species there is a departure from this form, and the two sides or margins of the scale may be straight and parallel or nearly so. The scales of the female are typically

dark in color, blackish or brownish, though in certain species the color is much lighter, varying from light brown to yellow or olivaceous. While in certain species the sides are nearly parallel, in most of the species the sides converge toward one end, the cephalic end, which bears the two exuviae. The exuviae overlap each other. The exuvia of the first nymph bears the remains of the antennae as porrect projections, while the exuvia of the second nymphal female is much larger and frequently covers about one-fourth of the outer surface of the scale. The ventral scale is always complete and continuous with the dorsal scale. In certain species the central part of the ventral scale is always thinner, the extent and position of the thinner portion is definite for each species and this thinner portion is ruptured when the scale is removed from the host-plant. In those species where the ventral scale is thicker and tougher, it is not ruptured when the scale is removed. This results in those species with a thin area of the ventral scale as being described as having a divided ventral scale and the others as having the ventral scale entire or complete. Where the ventral scale is very thin and all of it remains attached to the host-plant, it may be described as obsolete or wanting. The wax of the dorsal scale is usually comparatively thick and tough and not easily broken.

The scale of the male is elongate, about three times as long as broad with the single exuvia attached at the cephalic end. The sides of the scale are usually nearly parallel and in general the caudal portion is not much wider, as in the second nymphal scale and adult female scale of many species. The male scale is from one-half to one-third the length of that of the adult female. They are quite similar in color and general form to those of the female. There is frequently a thinner transverse band on the caudal part of the scale which serves as a hinge and allows the caudal end to be raised so as to permit of the escape of the adult male.

The species of this group are quite generally designated as the oyster-shell scales, because of their similarity in shape, color, and general appearance to the shell of an oyster. Unfortunately this resemblance is also found in a few species of Diaspidini, but the name of the oyster-shell scale has been so long applied to the common scale of the apple and to other species of the tribe that there is no hopes now of introducing a different name and it would be unwise to attempt it.

The body of the adult female is placed at the cephalic end of the scale under the exuviae and the eggs with the pulverulent

wax mixed with them are located under the caudal portion of the scale. In the adult female the body is elongate, typically about twice as long as broad, but in *Ischnaspis* it may be over four times as long as broad. The cephalic end is usually truncate or bluntly rounded. The antennae are represented by unsegmented tubercles, each bearing one or two long setae. The segmentation of the body is ordinarily distinguishable, but obscure. In *Opuntiaspis* and *Mytilella* the mesocoria is deep, particularly at each lateral margin, and the body appears to be divided into two portions. The segmentation of the preabdomen is usually distinct and sharply marked, particularly at each lateral margin. The caudolateral angles of these segments are frequently produced as rounded lobes and in some cases the lobes are prolonged and their lateral margins are strongly dentate so that each resembles a claw.

The division between the preabdomen and pygidium is generally distinct. The pygidial fringe is usually quite typical in form. There are generally two or three pairs of lobes, although there may be only a single pair, and in rare cases none at all. In a few species there are four pairs of lobes present, but the fourth pair is small and rudimentary. One or more of the pairs of lobes cephalad of the median pair is frequently deeply incised or completely divided. In the tables it is simply said to be incised. The second pair of lobes is usually incised only once, forming two lobelets, but the third pair while often incised only once may be incised several times in certain species. Each of these lobelets are frequently incorrectly designated and numbered as distinct lobes. Some species with only three pairs of lobes are said in such cases to have five or seven pairs. The margins of the lobes are usually notched, particularly the median lobes, and usually on both the mesal and lateral margins. The number of notches may be reduced in size and increased in number until their margins are crenulate or finely serrate.

Pectinae, if present, are of the type of *furcapectinae* and even such reduced pectinae are of rare occurrence. The plates are long, slender, and pointed. They are usually longer than the lobes. The number varies somewhat, but is usually 2, 2, 2, 2 or 2, 2, 2-3, 6. The pair of plates in the median incisura are rarely absent and some of the species referred here and lacking them, with more study, will probably be found to belong to the *Diaspidini*. The greatest variation in the number of plates is on the lateres which may bear only a few or a considerable number. This region is



*usually typical in form, rarely provided with densariae but may be finely serrate.*

The altaceratubae are usually large, with long tubes, their oraceratubae generally oblique to the tubes and distinctly longer than wide. In the lateres the altaceratubae are usually arranged in pairs and their oraceratubae open near together. The lamaceratubae are long and comparatively large. Their tubes can be traced through the plates to their oraceratubae located in the distal end. The brevaceratubae are usually numerous and are generally arranged in crescentic, often interrupted rows. While there is variation in the length of the tubes of the brevaceratubae, their tubes are usually longer than those of the brevaceratubae found in the Diaspidini.

The anal opening is probably more often located near the cephalic end of the pygidium than near the middle or caudal end. The vulva is located near the middle of the pygidium. It is surrounded by four or five groups of genacerores in fifteen of the genera and wanting in the other nine. The genacerores are present in much the greater number of species, since they are present in all the species of the typical genus *Lepidosaphes*, which contains nearly as many species as all the other genera together. The number of species with four groups of genacerores is small, less than ten per cent, and only rarely are the cerores of the groups combined so that it is not possible to identify their limits.

Much use has been made in the preparation of the following tables of the monograph of the *Mytilaspides* by Leonardi. The species distributed among the different genera are confined to two, *Lepidosaphes* and *Ischnaspis*, in Fernald's Catalogue and its supplements. The structures of the pygidium described in the tables are in every case those of the adult female unless otherwise specified.

The following species have been omitted from the tables for various reasons:—*abletis* Sign. from Europe on *Abies*; *ceratoniae* Genn. from Isle of Cyprus on *Ceratonia*; *flava* Targ. from Europe, Australia, China, Hawaiian Islands, and North America on olive; *juglandis* Sign. from France, Germany on *Juglans*, this is apparently the same as *ulmi* Linn.; *myrthi* Bouché from southern Europe on *Myrtus*, this is the same as *ulmi* Linn.; and *Mytilaspis* (*Coccomytilus*) *dispar* Vays. from Madagascar on *Manihot*. The following species are all from New South Wales: *chitinosus* Frogg. on *Templetonia*, *cortrioides* Frogg. on *Acacia*, *crassa* Frogg. on *Melaleuca*, *eucalypti* Frogg. on *Eucalyptus*, *lobulatus* Frogg. on *Casuarina*, *mulgae* Frogg. on *Acacia*, and *recurvata* Frogg. on *Acacia*. Two species, greeni Charmoy and *hibisci* Charmoy, are from the Island of Mauritius.

GENERA OF LEPIDOSAPHINI

- a. Pygidium of adult female with groups of generacerores.
- b. Pygidium of adult female with lobes arranged in pairs, median pair never fused into single projection.
- c. Pygidium of adult female always with plates cephalad of median pair of lobes.
- d. Pygidium of adult female never with paraphyses.
- e. Adult female with mesothorax and metathorax never separated by deep transverse constriction.
- f. Pygidium of adult female without lattice-shaped thickenings; usually with four or five large distinct groups of generacerores; preabdomen and pygidium frequently with numerous brevaceratubae.
- g. Pygidium of adult female with four pairs of lobes; second, third, and fourth pairs incised; median incisura without plates; scale of adult female with dense white cottony or fluffy covering of wax.-----  
*Trichomytilus* Leon.
- gg. Pygidium of adult female never with more than three pairs of lobes; second and third pairs sometimes incised; median incisura with or without plates; scale of adult female naked, not with dense white cottony or fluffy covering of wax.
- h. Pygidium of adult female with median pair of lobes rarely adjacent, if so, only at proximal ends and not forming single semicircular area.
- i. Adult female with pygidium and segments of preabdomen with distinct, irregular, subtransverse rows of oraceratubae, outlets of brevaceratubae; pygidium apparently always with altaceratubae.
- j. Pygidium of adult female always with plates in median incisura.
- k. Pygidium of adult female always with three pairs of lobes.—Type, *Lepidosaphes bicornis* G. & L.-----*Triaspidis* MacG.
- kk. Pygidium of adult female always with less than three pairs of lobes.
- l. Pygidium of adult female always with two distinct pairs of lobes.
- m. Adult female with cephalic end of body never provided with strongly chitinized tooth-like projections.
- n. Preabdomen with lateral margins of its segments never produced into claw-like processes.
- o. Adult female with cephalic end of the body never with a trans-

- verse constriction cephalad of antennae.
- p. Adult female with cephalo-lateral angles of body never produced into ringed horn-like projections; body always normal in form.-----  
*Lepidosaphes* Shimer.
- pp. Adult female with cephalo-lateral angles of body always produced into ringed horn-like projections.—Type, *Mytilaspis ocellata* Green.-----  
*Cornuaspis* Mac.
- oo. Adult female with cephalic end of body always with transverse constriction cephalad of antennae, separating off head-like portion.—Type, *Mytilaspis oculi* Green.  
*Cephalaspis* MacG.
- nn. Preabdomen with lateral margins of its segments always produced into prominent claw-like processes.—Type, *Lepidosaphes unguolata* Green.-----  
*Ungulaspis* MacG.
- mm. Adult female with cephalic end of body always provided with distinct numerous strongly chitinated tooth-like projections.—Type, *Mytilaspis ser-rifrons* Leon.-----  
*Scobinaspis* MacG.
- ll. Pygidium of adult female always with single pair of distinct lobes.—Type, *Mytilaspis wilga* Leon.-----  
*Leonardaspis* MacG.
- jj. Pygidium of adult female always without plates in median incisura.
- k. Pygidium of adult female never with prominent pygidial incision; median pair of lobes with proximal ends not adjacent.
- l. Pygidium of adult female always with more than one pair of lobes.—Type, *Mytilaspis intermedia* Mask.-----  
*Scrupulaspis* MacG.
- ll. Pygidium of adult female never with more than one pair of lobes.—Type, *Mytilaspis spinifera* Mask.-----  
*Berlesaspis* MacG.
- kk. Pygidium of adult female always with prominent pygidial incision; median pair of lobes with their proximal ends united.

1. Pygidium of adult female with three pairs of lobes.—Type, *Mytilaspis phymatodidis* Mask. ----- *Fusilaspis* MacG.
11. Pygidium of adult female with two pairs of lobes.—Type, *Mytilaspis nivea* Mask. --- *Albastaspis* MacG.
- ii. Adult female with pygidium and segments of preabdomen without subtransverse rows of oracratubae, forming outlets of brevaceratubae; pygidium always with altaceratubae.----- *Pinnaspis* Ckll.
- hh. Pygidium of adult female with median pair of lobes adjacent, two lobes together forming single semicircular area.—Type, *Lepidosaphes hemichionaspiformis* Green. ----- *Hemiaspis* MacG.
- ff. Pygidium of adult female with lattice-shaped thickenings and with three small indistinct groups of genacerores; preabdomen and pygidium without or with only few brevaceratubae.----- *Ischnaspis* Doug.
- ee. Adult female with mesothorax and metathorax separated by deep transverse constriction; pygidium with two pairs of lobes, second pair incised; median incisura with two plates. ----- *Mytilicla* Leon.
- dd. Pygidium of adult female with mesal pair of club-shaped paraphyses and with single pair of lobes.—Type, *Lepidosaphes hawaiiensis* Mask. ----- *Andaspis* MacG.
- cc. Pygidium of adult female always without plates cephalad of median pair of lobes, with three pairs of lobes, second pair incised; plates of median incisura very small.----- *Aonidomytilus* Leon.
- bb. Pygidium of adult female with median pair of lobes fused into single projection; sometimes with more than five groups of genacerores.—Type, *Mytilaspis uniloba* Knw.----- *Lepidaspis* MacG.
- aa. Pygidium of adult female without groups of genacerores.
- b. Pygidium of adult female always with at least one pair of lobes.
- c. Pygidium of adult female always with plates.
- d. Pygidium of adult female never with lattice-shaped thickenings.
- e. Adult female with mesothorax and metathorax never separated by deep transverse constriction.
- f. Pygidium of adult female with lateral margins broadly convexly convergent caudad, with caudal end convexly rounded, never truncate, with two, rarely three, pairs of lobes; median pair of lobes always different in form and size from the others; scale of male and female not with prominent transverse constrictions.
- g. Body with metacoria located near middle of its length; portion of body cephalad of metacoria usually

- only slightly longer than portion caudad of it, always less than twice as long. ----*Coccomytilus* Leon.
- gg. Body with metacoria located distinctly caudad of middle of its length; portion of body cephalad of metacoria more than twice as long as portion caudad of it.—Type, *Dinaspis ichesli* Leon.----*Dinaspis* Leon.
- ff. Pygidium of adult female with caudal end broadly truncate and bearing three pairs of pointed, triangular, equidistant, similar, subequal lobes; scale of male and female with six or more prominent transverse constrictions. -----*Allantomytilus* Leon.
- ee. Adult female with mesothorax and metathorax separated by deep transverse constriction; pygidium with three pairs of lobes. -----*Optuntiaspis* Ckll.
- dd. Pygidium of adult female always with distinct lattice-shaped thickenings; brevaceratubae few in number or wanting.—Type, *Ischnaspis spathulata* Lindgr.----*Parischnaspis* MacG.
- cc. Pygidium of adult female without plates.
- d. Pygidium with median pair of lobes at most never more than twice width of median lobe apart.
- e. Pygidium with two pairs of distinct lobes, median pair as large as second pair; preabdomen with caudo-lateral angles of segments with strong finger-like processes.—Type, *Mytilaspis argentata* Ckll.-----*Niveaspis* MacG.
- ee. Pygidium with two pairs of lobes, median pair minute, indistinct, not more than one-sixth width of second lobe; preabdomen with caudo-lateral angles not with finger-like processes.—*Fernaldella* Leon.—Type, *Mytilaspis indentata* Green. -----*Fernaldanna* MacG.
- dd. Pygidium with median pair of lobes four or more times width of median lobe apart; median and second pairs of lobes minute.—Type, *Mytilaspis beyeriae* Green.-----*Maskellanna* MacG.
- bb. Pygidium of adult female without lobes or plates, with four stout, equidistant, conical projections extending from surface of pygidium beyond its margin. -----*Phaulomytilus* Leon.

## SPECIES OF TRICHOMYTIUS

Pygidium with median pair of lobes prominent, bluntly rounded, longer than broad, entire, distant; second pair of lobes large, incised, mesal lobelet much smaller than lateral, bluntly pointed, entire; third pair of lobes broad, deeply and broadly incised, lobelets bluntly pointed, subequal, entire; fourth pair of lobes deeply incised, similar in size and form to third pair; plates arranged 0, 3, 3, 3, 2, long and slender, much longer than lobes; genacerores 5-6(13-18)19-24.—Australia on *Eucalyptus*. -----*formosus* Mask.

## SPECIES OF TRIASPIDIS

- a. Pygidium with second pair of lobes not incised, at most only notched.
- b. Pygidium with furcapectinae between lobes.

- c. Pygidium with second and third pairs of lobes denticulate at distal end; median pair of lobes obliquely truncate at distal end; lateres bearing furcapectinae; genacerores 8-11 (20-22) 20-22.—Australia on Banksia. -----*banksiae* Mask.
- cc. Pygidium with lobes broadly rounded at distal end and notched on mesal and lateral margins; lateres bearing plates; genacerores in five confused groups, 13-13 (20-22) 16-18.—*Pinaspis nitidus* Brittin (Green.)—New Zealand on *Dysoxylum*, *Atherosperma*, *Coprosoma*, *Rhipogonium*, *Pinus*. ----*pyriformis* Mask.
- bb. Pygidium with plates, never with furcapectinae between lobes; lobes notched or coarsely crenulate; second and third pairs much smaller than first; plates large and prominent, arranged 2, 2, 3, 4-6; genacerores 14-14 (23-31) 21-21.—New Zealand on *Leptospermum*. -----*leptospermi* Mask.
- aa. Pygidium with second pair of lobes incised.
  - b. Pygidium with third pair of lobes incised, at most only deeply notched on lateral margin.
    - c. Pygidium with each second and third incisura with two plates, also median incisura, and four on each lateris arranged in two groups of two each; median pair of lobes deeply notched on lateral margin, second and third pairs faintly notched; genacerores 9-11 (19-26) 18-25; mesospiracerores 9-14.—Australia on Eucalyptus. -----*bicornis* Green & Lldg.
    - cc. Pygidium with each second and third incisura with single plate.
      - d. Pygidium with two hair-like plates between median pair of lobes; plates arranged 2, 1, 1, 6, those of each lateris arranged in three equidistant groups of two each; median pair of lobes with two small lateral notches, second with single deep lateral notch, and third with two small notches; genacerores 7-7 (10-12) 10-12, five groups adjacent.—*Lepidosaphes fulleri* Fern.—Australia on Banksia. -----*elongata* Fuller.
      - dd. Pygidium with two plates between median pair of lobes as long as other plates and longer than median pair of lobes; plates arranged 2, 1, 1, 2, those of each lateris situated, one near third lobe and other near middle of lateris; median pair of lobes oblique, large, finely serrate, set in emargination; second pair of lobes large, truncately rounded, finely serrate, mesal lobelet as large or larger than median lobe; third pair of lobes comparatively large, truncately rounded, finely serrate, subequal to lateral lobelet of second pair; genacerores 0-7 (7-7) 3-3.—South Africa on *Loranthus*. -----*kameruncensis* Lindgr.
  - bb. Pygidium with third pair of lobes incised.
    - c. Pygidium with third pair of lobes not consisting of more than three lobelets.
      - d. Pygidium with each third lobe divided into two lobelets.
        - e. Pygidium with median pair of lobes with one notch on mesal and two on lateral margin.

- f. *Pygidium* with median pair of lobes large; second pair of lobes incised, mesal lobelet with notch on lateral margin; third pair of lobes with mesal lobelet pointed and smaller than lateral; plates arranged 2, 1, 1, 3, always simple, those of median incisura hardly longer than lobes and shorter than other plates; genacerores 27-27(28-35)31-33.—Mexico on *Ortica*.-----*mexicana* Ckll.
- ff. *Pygidium* with median pair of lobes large and prominent; second pair of lobes small, incised, two lobelets subequal; third pair of lobes small, deeply incised, mesal lobelet twice as broad as lateral, lateral lobelet bluntly pointed; plates arranged 2, 2, 2, 2, those of median incisura small, shorter than median pair of lobes, other plates long and stout, those of each lateris near third lobe; genacerores 5-5(7-10)7-9.—Mexico on *Chilopsis*.-----*chilopsidis* Marl.
- ee. *Pygidium* with median pair of lobes large, entire or finely serrate or slightly crenulate, not notched.
- f. *Pygidium* with single plate in each second incisura.
- g. *Pygidium* with genacerores 7-7(12-13)10-11; median pair of lobes large, pointed, finely serrate, distant; second pair of lobes incised, lobelets bluntly rounded, finely serrate, mesal lobelet largest; third pair of lobes smaller than second, similar in form, mesal lobelet largest; plates arranged 2, 1, 1, 2, those of each lateris situated, one near third lobe and other slightly beyond middle; second and third incisurae prolonged as pointed lobe-like structures bearing *Oraceratubae*.—South Africa on *Macrolobium*.-----*meridionalis* Lindgr.
- gg. *Pygidium* with genacerores 2-2(5-6)3-3; median pair of lobes large, bluntly rounded, oblique, serrate; second pair of lobes incised, lobelets bluntly rounded, almost entire, mesal lobelet longer and broader than lateral; third pair of lobes larger than usual, smaller than second pair, deeply incised, bluntly rounded, subentire; plates 2, 1, 1, 2, those of each lateris situated one near third lobe and other near cephalic end; median incisura deeply hollowed out, its plates subequal in length to median lobes; second and third incisurae with blunt lobe-like projections bearing *Oraceratubae*.—South Africa on *Crudia*.-----*crudiae* Lindgr.
- ff. *Pygidium* without plates in median incisura.
- g. *Pygidium* with median pair of lobes distant, at least not fused at proximal end.
- h. *Pygidium* with genacerores 9-9(16-18)9-10; median pair of lobes large, entire or slightly crenulate; second pair of lobes incised, mesal lobelet larger than lateral; third pair of lobes broad and very

short, deeply incised, lateral lobelet usually minutely crenulate; plates arranged 2, 0, 2, 5, those of each lateris in two groups, caudal group of one or two near third pair of lobes and cephalic group of two or three some distance cephalad of caudal group; lateral margin of three caudal segments of the preabdomen with three plates each.—Mexico on Mimosa. -----*mimosarum* Ckll.

- hh. Pygidium with genacerores 4-4(6-7)3-4; median pair of lobes pointed, finely serrate, distant; second pair of lobes incised, lobelets bluntly rounded, subentire, mesal lobelet larger than lateral, lateral different in shape but subequal in size to median lobe; third pair of lobes large, deeply incised, subentire, lobelets bluntly rounded, mesal lobelet much larger than lateral; plates arranged 2, 0, 1, 3, those of each lateris situated, one near third lobe, one near middle projection, and other at cephalic end; plates of median incisura as long as or longer than median lobes; second and third incisurae with blunt lobe-like projections bearing oracratubae; each lateris finely serrate with latidentes.—South Africa on Cynometra.-----*aberrans* Lindgr.

- gg. Pygidium with median pair of lobes fused at proximal end, the median incisura represented by narrow deep indentation, distal ends bluntly rounded, entire; second pair of lobes small, incised, lobelets adjacent to each other and median lobe; third pair of lobes deeply incised, tooth-like projections; plates arranged 2, 0, 2, 6, those of each lateris in three groups, group of two near third lobe, three equidistant near middle, and one at cephalic end; plates of median incisura short and slender, much smaller than other plates; postgenacerores four, others not determined.—India on Aglaia.-----*travancorensis* Lindgr.

- dd. Pygidium with each third lobe divided into three lobelets, median portion largest and lateral portion notched, not pointed; median pair of lobes notched on lateral and mesal margins; mesal lobelet of second pair notched on lateral margin; plates arranged 2, 1, 1, 2, all large and subequal in size, much longer than lobes, those cephalad of second pair of lobes sometimes furcapedinae; two plates of each lateris distant; genacerores 7-8(10-15)14-19.—Brazil on Baccharis. -----*perlonga* Ckll.

- cc. Pygidium with third pair of lobes consisting of considerable number of minute lobelets, always more than five; median pair of lobes large, rounded, entire; second pair of lobes incised, two lobelets entire and subequal; plates arranged 2, 2, 1, 2, those of median and second incisurae short, not at all or only



slightly longer than lobes adjacent to them, plates of each lateris distant; genacerores 7-7(11-12)8-14.—Australia on Eucalyptus. -----*ldgetti* Ckll.

## SPECIES OF LEPIDOSAPHE

- a. Pygidium with second pair of lobes not incised or at most only deeply notched.
- b. Pygidium with median pair of lobes with their proximal ends distant; plates of median incisura always much longer than median pair of lobes.
- c. Pygidium with median pair of lobes deeply notched on mesal and lateral margins; second pair of lobes smaller, notched on mesal and lateral margins, bluntly pointed; plates arranged 2, 2, 3, large and broad, much longer than lobes, three plates of each lateris near second lobe; lateris deeply incised and finely serrate; genacerores 3-3(5-8)3-6.—Australia on *Melaleuca*. -----*melaleucae* Mask.
- cc. Pygidium with median pair of lobes not deeply notched, finely serrate or entire.
- d. Pygidium with median pair of lobes broad, broadly rounded, finely serrate; second pair of lobes minute, inconspicuous; plates arranged 2, 2, 2, those of each lateris adjacent near second lobe; plates long and slender, distinctly longer than lobes; genacerores 3-3(7-10)7-9.—Japan on *Miscanthus*. -----*arti* Knw.
- dd. Pygidium with median pair of lobes subquadrangular, entire; second pair of lobes similar in shape and smaller; plates arranged 2, 2, 9, long and slender, much longer than the lobes, those of each lateris arranged in groups of three; lateres entire, not deeply incised; genacerores 1-7(15-15)15-22.—Algeria on *Ampelodesma*. -----*ampelodesmae* Newst.
- bb. Pygidium with median pair of lobes with their proximal ends adjacent.
- c. Pygidium with four groups of genacerores, (3-3)4-4; median pair of lobes longest on mesal half, lateral margin longer than mesal, both sloping and finely serrate; second pair of lobes much smaller and finger-shaped; plates arranged 2, 1, 1-3, those of median incisura small, those of each lateris much larger than others.—Japan on *Calicornia*, *Elaeagnus*, *Quercus*. -----*crawii* Ckll.
- cc. Pygidium with five groups of genacerores, 2-3(8-11)5-6.—This was described as variety of *crawii* Ckll. The figures of Maskell and Leonardi and description of Cockerell are more different than is implied by description by Maskell. Japan on *Quercus*. -----*canaliculata* Mask.
- aa. Pygidium with second pair of lobes incised.
- b. Pygidium with proximal ends of median pair of lobes distinctly separated.
- c. Pygidium with only single plate or without plates in each second incisura.

- d. Pygidium with single plate in each second incisura.
- e. Pygidium with furcapectinae on each lateris; plates and pectinae arranged 2, 1, 6, those of each lateris situated, two plates adjacent to each second lobe, four pectinae in two groups of two each equidistant from each other and caudal group of plates; median pair of lobes small, rounded, notched; second pair of lobes rounded, incised, lobelets entire or finely notched; genacerores 4.4(6-7)4.5.—Ceylon on *Lasianthus*. -----*lasianthi* Green.
- ee. Pygidium with plates on each lateris, never with furcapectinae.
- f. Pygidium with plates located on each lateris at caudal end, at cephalic end, and near middle, one of groups sometimes wanting.
- g. Pygidium with genacerores 6.6(10-12)8-10; median pair of lobes not especially large, rounded at ends, with minute lateral lobelets; second pair of lobes incised, mesal lobelet larger than lateral; plates arranged 2, 1, 3, those of each lateris situated, one near each second lobe, one near middle, and one at cephalic end.—Mexico on "Laurel-tree", *Yucca*, *Agave*. -----*nigra* Ckll.
- gg. Pygidium with genacerores 3.4(6-6)4.4.
- h. Pygidium with median pair of lobes oblique, fairly large, bluntly rounded, margins finely serrate; second pair of lobes large, incised, each mesal lobelet larger than median lobe, bluntly rounded, margin finely serrate; plates arranged 2, 1, 3, those of each lateris large and broad, situated one near each second lobe, one near middle, and one at cephalic end; plates of median and second incisurae large, as long as or longer than lobes.—South Africa on *Macrolobium*.-----*tenuior* Lindgr.
- hh. Pygidium with median pair of lobes broadly separated, not oblique, margins with mesal and lateral notches, with a median pointed process; second pair of lobes incised, mesal lobelet much larger than lateral and one-third width of median lobe; plates arranged 2, 1-0, 4, those of each lateris large and broad, in two groups of two plates each, one group near cephalic end and other midway between cephalic group and second lobe; plates of median incisura slender, longer than lobes; each second incisura with blunt projection bearing an oraceratuba; anus located cephalad of mesogenacerores.—Ceylon on *Hevea*.  
*fasciata* Green.
- ff. Pygidium with plates on each lateris at caudal end only; plates arranged 2, 1, 1-2, long, as long as lobes, broad at proximal end; median pair of lobes large,

symmetrical, broadly spatulate, indistinctly three-notched; second pair of lobes similar, much smaller, unsymmetrical, incised, lateral lobelet longer than broad; genacerores 3-3(7-8)7-8.—Turkey in Asia on *Juniperus*.-----*juniperi* Lindgr.

dd. Pygidium without plates in second incisurae.

e. Pygidium with median pair of lobes broad, broadly rounded, notched on lateral and mesal margins; second pair of lobes small, incised, mesal lobelet larger than lateral; plates arranged 2, 0, 4, those of each lateris arranged in two groups of two each, one near middle, other at the cephalic end; median incisura with pointed projection, second incisurae with blunt projection bearing oracera-tuba and seta; genacerores 3-4(6-6)4-4.—Philippine Islands, Ceylon on *Eugenia*, *Hevea*.-----*rubrovitatus* Ckll.

ee. Pygidium with median pair of lobes bluntly pointed, entire or inconspicuously notched, distant; second pair of lobes incised, mesal lobelet much larger than lateral; plates arranged 2, 0, 3, those of each lateris placed, one near each second lobe, one near middle, other at cephalic end; median incisura with spine-like projection between plates, each second incisura with lobe-like projection bearing oracera-tuba; genacerores 4-7(6-7)4-4.—Seychelles.-----*auriculata* Green.

cc. Pygidium with two plates in each second incisura.

d. Pygidium with median pair of lobes distinctly notched or coarsely crenulate on distal portion, never entire.

e. Pygidium never with more than four genacerores, nine pregenacerores, and nine postgenacerores, usually within following limits: 2-5(3-9)3-9.

f. Pygidium with median pair of lobes broader than long.

g. Pygidium with plates of median incisura subequal in length or shorter than median lobes; median pair of lobes broad and rounded, lateral margins usually notched, widely separated; second pair of lobes incised, entire; plates arranged 2, 2, 4-6, those of second incisurae long and slender, twice as long as median lobes; genacerores 2-5(3-6)3-6.—Algeria on *Ficus*.-----*minima* Newst.

gg. Pygidium with plates of median incisura always distinctly longer than median lobes.

h. Preabdomen with lateral margins of its caudal segment with four plates on each side; pygidium with median pair of lobes broad, subtruncate, notched on mesal and lateral margins; second pair of lobes incised, margins subtruncate; plates arranged 2, 0, 6, those of each lateris arranged in three equidistant groups of two each, one near second lobe, one near middle, and one at cephalic

- end; lateris irregular, dentate; genacerores 4-4 (6-6)5-6.—Philippine Islands on Cocos.-----  
*macgregori* Banks.
- hh. Preabdomen with lateral margins of its caudal segments with two plates on each side.
- i. Genacerores 4-4(4-4)4-4.—Italy on Ficus. -----  
*ficifolii* Berl.
- ii. Genacerores 3-5(5-8)4-7.—Italy on Ulmus.-----  
*ficifolii ulmicola* Leon.
- ff. Pygidium with median pair of lobes moderately long and narrow, always longer than broad; plates of median incisura always distinctly longer than median lobes.
- g. Scale of adult female reddish brown; ventral scale with two margins subadjacent, division between them linear; pygidium with median pair of lobes distant, notched on mesal and lateral margins; second pair of lobes incised, margins of lobelets entire or notched; plates arranged 2, 2, 2, 6, those between lobes shorter and smaller than others which are long and slender; genacerores 3-5(6-11)4-6.—United States, Mexico, South America, West Indies, Asia, Ceylon, Australia, South Africa on orange, lime, palms, magnolia. -----*gloverii* Pack.
- gg. Scale of adult female pale straw color or fulvous; ventral scale with two margins straight but distant, division between them not linear; genacerores 3-3(7-8)4-4.—Ceylon on unidentified shrub. -----  
*gloverii pallida* Green.
- ee. Pygidium never with less than five mesogenacerores, nine pregenacerores, and nine postgenacerores, usually within following limits: 5-14(9-24)9-23.
- f. Pygidium with conspicuous double transverse series of oraceratubae extending on each side from level of anus almost to margin; median pair of lobes conspicuous, bluntly pointed, irregularly crenulate or dentate; second pair of lobes small, incised, mesal lobelet larger; plates of usual number; genacerores 6-7(9-10)8-9.—Java on Coffea. -----*corrugata* Green.
- ff. Pygidium not with conspicuous double transverse series of oraceratubae.
- g. Pygidium with median pair of lobes crenulate at distal end, but not deeply notched, frequently pointed; mesogenacerores arranged in single transverse row.
- h. Pygidium with median pair of lobes pointed and finely serrate or crenulate.
- i. Body never with series of four or five stout spines on each side of metathorax and segments of preabdomen; pygidium with second pair of lobes incised, lateral lobelet much smaller than

*mesal, mesal lobelet sometimes with lateral notch; plates arranged 2, 2, 6, those of each lateris arranged in three equidistant groups of two each.*

j. Genacerores 5-8(9-17)7-12; mesospiracerores 6-9.—*Lepidosaphes beckii* Newm.—America, Europe, Africa, Asia, Australia on orange, lemon, citron, fig, grape-fruit, oak, croton, *Elaeagnus*, *Banksia*, *Taxus*, *Pomaderris*, etc. *pinnaciformis* Bouche.

jj. Genacerores 11-11 (10-13) 11-11.—Italy on olive. -----*pinnaciformis oleae* Leon.

ii Body with series of stout spines on each side of metathorax and each segment of preabdomen; pygidium with two distinct pairs of lobes and broad inconspicuous slightly projecting area in position of third pair; median pair of lobes large, margins minutely denticulate, sloping each side to blunt point; second pair of lobes smaller than median, incised, mesal lobelet much larger than lateral, lobelets bluntly pointed; plates slender, arranged 2, 2, 6, those of each lateris arranged in three equidistant groups of two each; mesospiracerores numerous, metaspiracerores wanting; genacerores 4-7(11-14)12-15; anus located cephalad of mesogenacerores and vulva between postgenacerores.—Australia on *Cassinia*.-----*cassiniae* Green.

hh. Pygidium with median pair of lobes bluntly pointed.

i. Genacerores 4-4(11-13)7-8; pygidium with median pair of lobes bluntly pointed and finely serrate; second pair of lobes incised, lateral lobelet much smaller than mesal; plates arranged 2, 2, 6, those of each lateris arranged in three equidistant groups of two each; median incisura with marginal projecting point.—India on *Piper*. -----*piperis* Green.

ii. Genacerores 6-6(7-7)9-9; pygidium with median pair of lobes well developed with crenulate margins; second pair of lobes incised, margins of lobelets crenulate; plates large and prominent, arranged 2, 2, and several on each lateris.—Japan on vine.-----*buzenensis* Knw.

gg. Pygidium with median pair of lobes blunt at distal end, notched, not crenulate or finely serrate, sometimes with smaller indentations within notches; mesogenacerores always arranged in two or more transverse rows.

h. Pygidium with six plates on each lateris; median

pair of lobes large, broad, blunt, deeply notched on mesal and lateral margins; second pair of lobes incised, mesal lobelet much larger than lateral, their margins entire or irregularly notched; plates arranged 2, 2, 6, those of each lateris arranged in three equidistant groups of two each; genacerores 5-14(9-24)8-18; mesospiracerores 3-6.—United States, Brazil, Europe, Japan, Australia on elm, apple, pear, plum, willow, dogwood, poplar, etc. -----*ulmi* Linn.

hh. Pygidium with five plates on each lateris; median pair of lobes large, broad, blunt, deeply notched on mesal and lateral margins; second pair of lobes incised, mesal lobelet much larger than lateral; plates arranged 2, 2, 6, those of each lateris arranged in three equidistant groups, two at caudal end, two at cephalic end, and one near middle; genacerores 10-10(14-14)21-23; mesospiracerores 11.—New Zealand on Pittosporum.-----*multipora* Leon.

dd. Pygidium with median pair of lobes entire and rounded at distal end, at most, only finely notched.

e. Pygidium with mesal lobelet of each second lobe never approximating median lobe in size, always much smaller.

f. Pygidium with median pair of lobes broader than long, subtriangular in outline; second pair of lobes incised, two lobelets subequal in length, margins entire; plates arranged 2, 2, 6, those on each side of each second pair of lobes distinctly shorter than others, each lateris with plates arranged in three equidistant groups of two each, two cephalic groups in deep indentations; genacerores 4-4(7-9)7-8.—Japan on Eurya.-----*curyac* Knw.

ff. Pygidium with median pair of lobes as long as or longer than broad, sometimes faintly or irregularly notched, distal end broadly rounded or truncated; second pair of lobes incised, two lobelets with entire margins, mesal distinctly longer than lateral; plates arranged 2, 2, 4, those on each side of each second pair of lobes subequal in length to those of median incisura, each lateris with four plates in three equidistant groups, two at caudal end, one near middle, and one at cephalic end, those of two cephalic groups much smaller than plates of caudal group; genacerores 1-7(7-13)7-12; mesospiracerores 2-3.—Bohemia, Japan on Pinus.-----*newsteadi* Sule.

ee. Pygidium with mesal lobelet of each second lobe equal to median lobe in size; median pair of lobes as broad as long, lateral and distal margins convex, converging, distal end rounded, entire; second pair of lobes incised, mesal lobelet as large as median lobe, broader than long, subquad-

angular, distal margin oblique, entire, lateral lobelet triangular, minute; plates of incisurae subequal in length to lobes, others longer, arranged 2, 2, 1-2-2-2; each lateris with broad cristate prominence in position of third lobe; altaceratubae four on each side, arranged 1-2-1; dorsal oraceratubae few in number, arranged in rows; anus located cephalad of mesogenacerores; genacerores 3-5(6-9) 7-9.—Seychelles on cocoanut palm.-----*duponti* Green.

- bb. Pygidium with proximal ends of median pair of lobes contiguous or nearly so; median pair of lobes large, with one mesal and two lateral notches; second pair of lobes minute, incised, mesal lobelet larger than lateral, with lateral notch; plates arranged 2, 2, 6, those of second incisurae much smaller than others, each lateris with six subequidistant plates in three groups of two each; genacerores 7-12(9-15)7-12; mesospiracerores about 3.—Europe on fig. -----*ficus* Sign.

#### SPECIES OF CORNUASPIS

- a. Body with cephalic end rounded with well defined eye-spots surrounded by fine concentric lines on a level with rudimentary antennae; pygidium with median pair of lobes broad, distant; second pair of lobes incised, each lobelet distinctly less than one-half size of each median lobelet; plates arranged 2, 2, 6; genacerores 2-4(9-10)7-8.—Seychelles on Davallia. -----*ocellata* Green.
- aa. Body with cephalic end truncate, its lateral angles produced into ringed horn-like papillae; pygidium with median pair of lobes rounded and notched on lateral and mesal margins; second pair of lobes incised, entire or nearly so; furcapectinae arranged 2, 1, 5, projection on one side of furcapectinae small and distant from distal end; genacerores consisting of twenty-four cerores arranged in a crescent, 4-4(6-7)4-6.—Philippine Islands on Cocos.-----*unicolor* Banks.

#### SPECIES OF CEPHALASPIS

Pygidium with median pair of lobes bluntly pointed and finely serrate; second pair of lobes incised, lateral lobelet much smaller than mesal, entire; plates arranged 2, 2, 6, those of each lateris arranged in three equidistant groups of three each; two caudal segments of preabdomen on each side with four or five plates; genacerores 1-6(8-13)6-8; mesospiracerores 3-4.—Ceylon on *Cocculus*.-----*cocculi* Green.

#### SPECIES OF UNGULASPIS

Preabdomen with margins of its segments strongly produced and produced portions with claw-like processes; pygidium with median pair of lobes faintly notched on lateral and mesal margins; second pair of lobes incised, mesal lobelet much larger than lateral; plates arranged 2, 2, 6; each lateris with three indentations, each with pair of plates; genacerores 3-3(6-9)4-6.—Java on *Syzygium*.-----*ungulata* Green.

#### SPECIES OF SCORINASPIS

Head with cephalic and ventral aspects in region of antennae with number of tooth-like projections; pygidium with median pair of lobes short and broad, faintly notched on mesal and lateral margins; second pair of lobes incised, lateral lobelet much smaller than mesal;

plates arranged 2, 2, 5, slender in form and longer than lobes, those of each lateris arranged in three equidistant groups of one, two, and two; genacerores 4-4(5-6)4-6.—Italy on Croton.-----*scrrifrons* Leon.

SPECIES OF LEONARDASPIS

**Pygidium** with only single pair of distinct lobes, the median pair short, about as broad as long, distal margin broad, notched on mesal and lateral margins; plates arranged 2, 3, those of median incisura short and small, hardly longer than median pair of lobes, those of each lateris much longer and arranged singly and distant from each other; margin of lateris thickened, toothed; genacerores 5-5(24-27)29-35.—Australia on an unknown plant. -----*willga* Leon.

SPECIES OF SCRUPULASPIS

- a. **Pygidium** with second pair of lobes not incised.
- b. **Pygidium** with median and second pairs of lobes distant, distance between them greater than width of one of second pair of lobes.
- c. **Pygidium** with median pair of lobes as broad as long.
- d. **Pygidium** with median pair of lobes broad, lateral margin slightly crenulate, projecting very slightly.
- e. **Pygidium** with genacerores 9-15(13-17)10-17; second pair of lobes small, rounded, entire; plates arranged 2, 4, 12, those of median incisura largest, resemble large setae, those of second incisura short, subdivided, pectinae-like, may be typical number or toothed prolongations of margin, those cephalad of each second pair of lobes six or seven, subdivided, and two distant groups cephalad of these on each lateris.—New Zealand on *Leptospermum*...  
*intermedia* Mask.
- ee. **Pygidium** with genacerores 1-3(6-9)4-7; median pair of lobes narrower than in typical form, other lobes obsolescent; plates very small and inconspicuous; lateral margins of segments of preabdomen not markedly produced.—Australia on *Acacia*.....*intermedia victoriae* Green.
- dd. **Pygidium** with median pair of lobes small, only slightly projecting, rounded, truncate, entire; second pair of lobes small, finger-shaped, bluntly pointed; plates arranged 0, 1, 3, those of each second incisura filling space between lobes, as broad as median lobe, with spine-like projection on mesal corner, hardly longer than lobes, those of each lateris situated, small one near second lobe, one at middle, third at cephalic end; caudal segment of preabdomen with two plates on each side; median pair of lobes adjacent; genacerores 4-4(12-16)12-13.—Java on *Persea*.....*longula* Leon.
- cc. **Pygidium** with median pair of lobes triangular or subtriangular, longer than broad, margins entire; second pair of lobes similar in general form to median but smaller, entire; plates arranged 0, 2, 3, those of second incisurae about as long as



second pair of lobes, those of each lateris in two distant groups, two and one; genacerores 2-4(6-9)1-6.—Australia.-----

*defecta* Mask.

- bb. Pygidium with median and second pair of lobes close together, not as far apart as width of one of second lobes.
- c. Pygidium with second pair of lobes distinctly narrower than median pair.
- d. Pygidium with median pair of lobes large, broadly rounded, not notched, finely serrate; second pair of lobes minute, triangular, adjacent to first lobe, margin irregular; plates large, arranged 0, 0, 4, those of each lateris arranged two adjacent to each second lobe, shorter than other plates, one near middle, and fourth at cephalic end; genacerores 8-10 (14-15)16-24.—Australia on *Banksia*.-----*grandilobis* Mask.
- dd. Pygidium with median pair of lobes triangular.
  - e. Pygidium with median pair of lobes with margin broadly crenulate, triangular in outline with distal end bluntly rounded; second pair of lobes broadly rounded, subtriangular, near but not adjacent; plates apparently wanting; genacerores 4-6(6-8)8-10.—Japan on *Machilus*.-----*machili* Mask.
  - ee. Pygidium with median pair of lobes with margin entire, triangular in outline, apex nearer mesal margin, mesal and lateral margins forming unbroken curve with distal margin, lobes separate but close together, lateral margins oblique; second pair of lobes with mesal half almost as large as median lobe and of much same shape, lateral half about one-half as broad, shorter and rectangular; plates arranged 0, 1, 2-2-2, plates of median incisura diverging caudad; altaceratubae arranged 1-2-2-1; genacerores present; body with triangular process on each side projecting cephalad of mouth-parts and margin slightly bulged out.—Ceylon on *Mesua*.-----*ambigua* Ruth.
- cc. Pygidium with second pair of lobes broader or subequal in length with median pair, broadly rounded at distal end, mesal margin notched; plates arranged 0, 1, 3, those of each lateris placed equidistant from each other, all large; genacerores 3-4(7-11)7-10.—Australia on *Casuarina*.-----*casuarinae* Mask.
- aa. Pygidium with second pair of lobes incised.
  - b. Pygidium with median pair of lobes broadly rounded, entire; second pair of lobes incised, mesal lobelet largest, both lobelets notched; third pair of lobes rudimentary, incised, notched, irregular in outline; plates arranged 0, 2, 2, 1, situated on each lateris near third lobe; genacerores 4-5(10-13)11-15.—Australia on *Eucalyptus*, *Acacia*.-----*grisea* Mask.
  - bb. Pygidium with median pair of lobes with single mesal notch and several lateral notches, bluntly pointed between notches; second pair of lobes incised, entire, mesal lobelet twice as large as lateral; third pair of lobes very small, entire, not incised;

plates arranged 0, 2, 2, 4, those of each lateris arranged in two groups of two each, two near third lobe and others near cephalic end; genacerores 4-4(6-7)5-5.—Italy on *Phillyrea*.-----  
*destefanii* Leon.

SPECIES OF BERLESASPIS

- a. Pygidium with median pair of lobes with distal end truncated and with sides parallel and distal end pointed.
  - b. Pygidium with median pair of lobes longer than broad, large, distant, projecting, two sides of each lobe parallel, distal portion pointed; other lobes apparently obsolete; plates apparently wanting in median incisura, each lateris with six to eight; genacerores 2-6(8-10)10-15; mesospiracerores 4.—Australia on *Acacia*.-----  
*spinifera* Mask.
  - bb. Pygidium with median pair of lobes short, broader than long, distal ends truncate, not distant; plates wanting in median incisura and each lateris with eight to ten; genacerores 4-6(12-16)14-16.—New Zealand on *Astelia*.-----  
*epiphytidis* Mask.
- aa. Pygidium with median pair of lobes conical, not notched; plates arranged 2, 3, all minute; genacerores 2-3(7-9)1-15.—Australia on *Melaleuca*.-----  
*spinosa* Fuller.

SPECIES OF FUSILASPIS

- a. Pygidium with second pair of lobes incised two or three times.
  - b. Pygidium with each lateris with five or six plates; median pair of lobes irregular, not projecting beyond pygidial incision; second pair of lobes small, incised, forming two subequal lobelets; third pair of lobes short and broad, divided by incisions into three lobelets, median largest; plates arranged 0, 1, 1, 5-6, plates of each lateris grouped one near third lobe, one near middle of lateris, others near cephalic end; genacerores 7-8(10-15)16-18; mesospiracerores 3-7.—Australia on *Phymatodes*.-----  
*phymatodidis* Mask.
  - bb. Pygidium with two plates on each lateris.
    - c. Pygidium with second and third pairs of lobes each divided into three lobelets, median lobelet in each case largest, margins of all entire; median pair of lobes fused to form crescentic area with caudal ends bluntly rounded; plates large and prominent, arranged 0, 1, 1, 2, those of each lateris far apart; genacerores 7-14(14-20)17-24.—Australia on *fan-palm*.-----  
*pallens* Mask.
    - cc. Pygidium with second pair of lobes divided into four lobelets and third pair into three, margins entire or irregularly crenulate; median pair of lobes fused to form crescentic area with lateral ends prolonged and broadly rounded; plates large and prominent, arranged 0, 1, 1, 2, those of each lateris far apart; genacerores 7-9(14-23)20-28.—New Zealand on *Cordylina*, *Asplenium*, *Phormium*, *Gahnia*, *Drimys*, *Astelia*, *Eucalyptus*.-----  
*cordylinidis* Mask.
- aa. Pygidium with second pair of lobes simple, not incised, margin

## THE COCCIDAE

rounded and entire, located near to fused median pair of lobes; median pair of lobes strongly produced, broadly rounded, finely serrulate; third pair of lobes small, incised; plates large, arranged singly and equidistant; lateris irregular and finely serrate; genacerores 0, 1, 1, 4, those of each lateris placed separately and equidistant; genacerores 6-8 (20-25) 25-35.—New Zealand on *Fuchsia*.—*lactea* Mask.

## SPECIES OF ALBATASPIS

Pygidium with two pairs of lobes; median pair with lateral ends prolonged and crenulate; second pair of lobes large, incised, mesal lobelet longest, bluntly rounded, lateral lobelet pointed; plates long and broad at proximal end, arranged 0, 1, 3, those of each lateris placed singly and equidistant; lateris irregular and finely serrate; genacerores 2-5 (5-14) 15-24.—Australia on *Melaleuca*.-----*nivea* Mask.

## SPECIES OF PINNASPIS

- a. Scale of adult female with a median keel and inclined to be tricarinate; pygidium with median pair of lobes closely approximated, notched on lateral margin, broadly rounded; second pair of lobes small; third pair rudimentary; plates arranged 0, 1, 1, 2, those of second incisurae small, those of third large, those of each lateris large and one located near each end; each lateral margin of caudal segment of preabdomen with two plates.—Jamaica on bamboo.-----*bambusae* Ckll.
- aa. Scale of adult female not with median keel and never tricarinate.
  - b. Pygidium with second pair of lobes incised, mesal lobelet larger than lateral; median pair of lobes prominent, almost contiguous, rounded, with notch on lateral margin; plates arranged 0, 1, each lateris with a few plates; lateres serrate; genacerores 4-4 (10-10) 9-11.—Philippine Islands on *Celtis*, *Sandoricum*, *Siphonodon*.-----*siphonodontis* Ckll. & Rob.
  - bb. Pygidium with second pair of lobes not incised.
    - c. Body without groups of mesospiracerores; pygidium with median pair of lobes adjacent, distal end rounded, notched on lateral margin; second pair of lobes bluntly rounded, short, curved mesad; plates arranged 0, 1, 3, those of each lateris situated one near each second lobe, one near middle, one near cephalic margin; genacerores 5-5 (13-15) 12-13.—Java on *Persea*.-----*rombica* Leon.
    - cc. Body with groups of mesospiracerores.
      - d. Pygidium with median pair of lobes rounded, adjacent, deeply notched on lateral margin; second pair of lobes small, rounded, spatulate; plates arranged 0, 1, 3, those of each lateris situated, one near second lobe, one near middle, third at cephalic end; each lateral margin of caudal segment of preabdomen with two plates; genacerores 4-4 (9-12) 11-13; mesospiracerores about 3.—*Mytilaspis pandani* Comst.—Massachusetts, New York, West Indies, Panama, Europe on *Buxus*, *Dictyosperma*, *Areca*, *Pandanus*, *Anthurium*, *Thrinax*, *Dracaena*, *cocoa-palm*.-----*buxi* Bouche.

- dd. Median pair of lobes uniformly rounded, entire, not notched, scarcely adjacent, mesal margins divergent; second pair of lobes similar to first, entire, not notched; small rounded lobelet caudad of second lobe may be lateral lobelet of second lobe; plates arranged 0, 1, 3, those of each lateris situated, one near second lobe, one at middle, one at cephalic end; genacerores 6-6(16-17)11-12; mesospiracerores 7-10.—Java on *Ilex*. -----*-javanica* Leon.

SPECIES OF HEMIASPIS

Pygidium of median pair of lobes adjacent, semicircular in form, margins entire, lateral margin entire or with faint notch; other lobes wanting; plates flattened, caudal one not as long as lobes, arranged 0, 1-1-1, cephalic plate very broad; minute paraphyses, two pairs, or thickenings located between caudal, first and second, and second and third plates; dorsal oracreratubae few; genacerores 4-4(6-6)4-4.—*Lepidosaphes hemichionaspiformis* Green.—North Australia on *Mela-leuca*. -----*-hemichionaspiformis* Green.

SPECIES OF ISCHINASPIS

- a. Pygidium with two plates in each second incisura; plates arranged 0, 2, 6, those of each lateris two, distant, at caudal end, two subadjacent one-third from caudal end, and two subadjacent near cephalic end; median pair of lobes broadly rounded, widely separated, not oblique, finely serrate; second pair of lobes incised, each lobelet similar to median, entire, broadly rounded, mesal lobelet larger than lateral; large oracreratubae in each second incisura laterad of its plates and another laterad of each second lobe; margin of pygidium broadly concave between caudal oracreratubae; genacerores in three groups, median group 3-4 and each lateral group 4-6.—*Lepidosaphes ritsema-bosi* Leon.—United States, West Indies, Brazil, Great Britain, Japan, Australia on *Pandanus*, *Lantana*, *Magnolia*, *Jasminum*, *Monstera*, palms, coffee, etc.-----*-longirostris* Sign.

- aa. Pygidium with single plate in each second incisura; plates arranged 0, 1, 3, those of each lateris situated, one near second lobe, one near middle, and third near cephalic end; median pair of lobes large, broadly rounded, strongly oblique, distinctly separated, finely serrate; second pair of lobes small, incised, mesal lobelet much larger than lateral, bluntly rounded, serrate; oracreratubae in each second incisura adjacent to second lobe, two adjacent ones cephalad of caudal plate of each lateris and one cephalad of each of other plates; pygidial margin deeply concave between plates of second incisurae and median lobes situated in concavity; genacerores arranged in five groups, 2-3(6-12)4-4; mesospiracerores 0-1.—South Africa on *Cyclostomum*, *Strychnos*. -----*-bipindensis* Lindgr.

SPECIES OF MYTILELLA

Pygidium with median pair of lobes inconspicuous, tooth-shaped, faintly notched on lateral margin, distant; second pair of lobes incised, mesal lobelet slightly larger than lateral, notched on lateral margin,

lobelets similar in form, bluntly rounded; plates arranged 2, 1, 7, those of each lateris situated, one adjacent to each second lobe, three equidistant groups of two each; each lateris between caudal and next group of plates with four or five adjacent oraceratubae; genacerores (4-4) 4-4; mesospiracerores two.—Central America on *Anthurium*-like plant. -----*carinata* Kkll.

## SPECIES OF ANDASPIS

- a. Pygidium with two mesal club-shaped paraphyses connected with mesal margins of median pair of lobes; median pair of lobes distinct, triangular, lateral margin long, minutely serrate, mesal notch small; other lobes wanting; plates longer than lobes, arranged 2, 1-2-2-1; margin with six altaceratubae arranged 1-2-2-1; anus superimposed over mesogenacerores; vulva located between pregenacerores and postgenacerores; mesospiracerores 1-2, metaspiracerores 0; dorsal oraceratubae small, in two rows; genacerores 4-5 (5-6) 4-5.—*Lepidosaphes flava hawaiiensis* Mask., *Lepidosaphes erythrinae* Rutherford, *Lepidosaphes moorosi* Doane & Ferris.—Ceylon, Hawaiian Islands, Samoan Islands on *Erythrina*, orange. ....*hawaiiensis* Mask.
- aa. Pygidium with two pairs of paraphyses, none connected with lobes; median pair of lobes large, triangular, adjacent, distal ends meeting like pair of pincers; other lobes wanting; altaceratubae opening in latadentes, arranged 1-(1-1)-(1-1)-1-(1-1); plates small and inconspicuous, shorter than lobes, arranged 0, 2-1-11; anus nearly over mesogenacerores; dorsal oraceratubae very few; mesospiracerores 2-3; genacerores 3-5 (7-12) 8-12.—*Lepidosaphes incisor* Green.—North Australia on *Melaleuca*. -----*incisor* Green.

## SPECIES OF AONIDOMYTIUS

Pygidium with three pairs of lobes, median pair large, mesal and lateral notches deep; second pair of lobes incised, mesal lobelet pointed with deep mesal and lateral notch; third pair of lobes triangular, not incised; plates arranged 2, 0, 0, 0, limited to minute plates in median incisura, shorter than median lobes; genacerores 3-3 (4-4) 2-3.—New Mexico, Colorado on *Chenipodium*, *Atriplex*. -----*concolor* Kkll.

## SPECIES OF LEPIDASPIDIS

Pygidium with single, large, mesal, crenulate lobe; four distant plates on each side, cephalic two much larger than caudal two; genacerores arranged in five groups, 4-4 (10-12) 11-14, some individuals possess four groups arranged in transverse row cephalad of mesogenacerores, each group with two to three cerores; caudal segment of preabdomen with two large plates, segments not deeply constricted; scale of adult female narrow, straight or curved, sides subparallel, with whitish, narrow flattened border; color dark brown with pale margin, older specimens pale white.—Japan on *Osmanthus*. -----*uniloba* Knw.

## SPECIES OF COCCOMYTIUS

- a. Preabdomen with lateral margin of each segment with row of short, thick, tubular bristles, "some with a circular top, some forked,

and some appearing like bundles of parallel fibres (pectinae and plates or setae);" pygidium with two pairs of subsimilar, not incised lobes.—New Zealand on *Drimys*.-----*drimydis* Mask.

- aa. Preabdomen not with lateral margin of each segment fringed with row of pectinae or plates or setae.
  - b. Pygidium with plates between median pair of lobes.
    - c. Pygidium with three pairs of lobes.
      - d. Pygidium with second pair of lobes incised.
        - e. Pygidium with third pair of lobes incised.
          - f. Pygidium with median pair of lobes short and broad, distinctly broader than long, bluntly rounded, faintly notched on mesal and lateral margins, distant; second pair of lobes incised, mesal lobelet much larger than lateral, bluntly pointed, faintly notched on mesal and lateral margins; third pair of lobes incised and notched; plates arranged 2, 2, 2, 4, those of each lateris situated, one adjacent to third lobe, two near middle, distant from each other, one at cephalic end; each lateris more or less scalloped and indented.—*Lepidosaphes cockerelliana* Kirkaldy.—Florida, New Mexico, Mexico, Bahama Islands, Jamaica on *Solanum*.-----*albus* KcIl.
          - ff. Pygidium with median pair of lobes large, rounded, entire, not far apart; second pair of lobes incised, mesal lobelet larger than lateral, lateral margin of mesal lobelet minutely crenulate; third pair of lobes incised, margins crenulate, lateral lobelet broadest; each lateris irregularly serrate, with one or two pointed processes.—Mexico on "Garabaillo."-----*townsendiana* KcIl.
  - ce. Pygidium with third pair of lobes not incised; median pair of lobes broad, as broad as long, sloping on both margins to blunt point, minutely dentate, proximal half of margins subparallel; second pair of lobes incised, mesal lobelet much larger than lateral, similar to median lobe, more or less notched on each side, lateral lobelet bluntly pointed, entire; third pair of lobes short, broad at proximal end, rounded; plates subequal in length to lobes, arranged 2, 2, 3, 3; dorsal *oracratubae* prominent.—Philippine Islands on *Ixora*.-----*ixorae* KcIl. & Rob.
  - dd. Pygidium with second pair of lobes not incised; median pair of lobes large, margins strongly sloping, converging caudad, distal end bluntly pointed; second pair of lobes minute, subtriangular in outline; third pair of lobes similar in size and shape to second pair; plates of median *incisura* shorter than lobes, those of other *incisurae* and *lateris* variable in length, arranged 2, 2, 3-4, 3, those of each lateris near a lobe; *brevaceratubae* few in number.—Australia on *Hymen-anthera*.-----*hymen-antherae* Green.
- cc. Pygidium with two pairs of lobes.

- d. Pygidium with two plates in each second incisura; second pair of lobes not incised.
- e. Pygidium with median pair of lobes broader than long, short, bluntly rounded, notched on mesal and lateral margins, distant; second pair of lobes not incised, rounded, faintly serrulate, two rounded lobe-like projections cephalad of each second lobe; median and second incisurae each with two plates, each lateris with four or five plates, those of median incisura large, as long as lobes; lateres with small serrulations.—Australia on Acacia.-----  
*convexus* Mask.
- ee. Pygidium with median pair of lobes entire, broader than long, distal end truncated with rounded angles, margin finely crenulate, distant; second pair of lobes not incised, bluntly rounded, faintly notched; plates arranged 2, 2, 8, those of incisurae short and stout, shorter than lobes and plates of lateres, plates of each lateris arranged in three groups, three near second lobe, three near middle, two at cephalic end; lateres irregular and serrate.—Australia on Acacia. -----*acaciae* Mask.
- dd. Pygidium with single plate in each second incisura; median pair of lobes pointed, finely serrate, sides strongly roundly converging; second pair of lobes large, incised, mesal lobelet twice as large as lateral, distal end subtruncate, margins of lobelets finely serrate; plates arranged 2, 1, 6, those of median incisura minute, not one-half length of median lobe, all others stout and much longer than lobes, those of each lateris arranged, one adjacent to second lobe, two near middle, three at cephalic end; oracratubae located, one in each second incisura, two between two caudal groups of plates of each lateris and adjacent, three adjacent ones between the two caudal groups of plates.—South Africa on Berlinia. -----*chitinosus* Lindgr.
- bb. Pygidium without plates between median pair of lobes.
- c. Pygidium with two pairs of rounded, produced, very distinct lobes; median pair of lobes largest, distant; median incisura with short bifid process; plates arranged 0, 1, 4, those of each second incisura long, nearly twice as long as lobe, those of each lateris arranged, one adjacent to second lobe, three equidistant from each other and caudal one; lateris with obtuse projections; mesal forked organ may be median pair of lobes.—Brazil on bamboo. -----*bambusicola* Kkil.
- cc. Pygidium with median pair of lobes large and broad, adjacent, mesal margin with single notch and lateral with two, distal portion of lobes bluntly rounded; second pair of lobes much smaller than median, incised, entire, each mesal lobelet larger than lateral, adjacent to median lobe; third pair of lobes almost obsolete; plates arranged 0, 0, 3, those of each lateris very large, distal portions elongate and finely attenuate, one

placed near third lobe, two adjacent near cephalic end.—Jamaica on Croton. ----- *crotonis* Ckll.

SPECIES OF DINASPIS

- a. Pygidium with three pairs of lobes; median pair short, bluntly rounded, entire, less than width of one of them apart; second pair of lobes similar in size and form to the first pair, entire; third pair of lobes small, inconspicuous, distant from second pair; plates arranged 2, 1, 1, 0, small, only slightly longer than lobes, those of each second incisura adjacent to second lobe; oraceratubae situated one in each second incisura, two in each third incisura and adjacent, one adjacent to cephalic margin of each third lobe, fifth slightly farther cephalad.—Argentina on Ephedra. ----- *ichesi* Leon.
- aa. Pygidium with two pairs of lobes; median pair of lobes short, bluntly rounded, entire, twice width of one of median pair of lobes apart; second pair of lobes small, not incised, entire, bluntly pointed, distant from median pair of lobes; plates arranged 2, 1, 3, those of each lateris situated one near second lobe, two short distance cephalad; oraceratubae situated, one in each second incisura, five others equidistant from each other and one in second incisura.—Argentina on Bulvesia. ----- *lahillei* Leon.

SPECIES OF ALLANTOMYTHIUS

Pygidium with caudal margin truncate and bearing three pairs of similar, very distinct, subequal, triangular lobes with mesal and lateral margins faintly notched; plates arranged 2, 2, 2-3, 1, all subequal in size and much longer than lobes; segments of preabdomen with their lateral margins bearing three or four broad furcapectinae; scale of male and female with six or more deep transverse constrictions.—Australia on Litsa. ----- *maideni* Mask.

SPECIES OF OPUNTIASPIS

- a. Pygidium with three pairs of lobes; median pair prominent, distant, broadly rounded, slightly notched; second pair of lobes twice incised, cephalic and median lobelets subequal, bluntly pointed, smaller than median lobelet, entire; third pair of lobes equally prominent, once incised, lobelets bluntly pointed, entire; plates arranged 2, 1, 1, 2, 6-7, those of each lateris in two groups, two situated near each third lobe, four or five spaced on cephalic portion; mesospiracerores 5-6; each lateris indented and finely serrate.—Mexico on Yucca, Agave. ----- *philococcus* Ckll.
- aa. Pygidium with two pairs of lobes; median pair of lobes long, prominent, bluntly pointed, slightly constricted at proximal end; second pair of lobes incised, mesal lobelet twice as large as lateral, bluntly pointed, each subsimilar to median lobe; plates arranged 2, 1, 2; each lateris cephalad of second lobe with two latadentes, each with an oraceratuba, each second incisura with latadententis with oraceratuba between plate and second lobe.—Java on Agave. ----- *javanensis* Green.

SPECIES OF PARISCHNASPIS

Pygidium of adult female without genacerores; median pair of lobes broadly rounded, strongly oblique, distinctly separated, crenulate; sec-



ond pair of lobes large, incised, mesal lobelet much larger than lateral, margin finely serrate, truncate; third pair of lobes as large as second, incised, similar in form; plates arranged 0, 1, 1, 4, those of each lateris situated, one adjacent to third lobe, one near middle, two at cephalic end, these plates much larger than others; oraceratubae situated one on meson, one in each second incisura, one in each third incisura, one between lobelets of each third pair of lobes, two cephalad of first plate of each lateris, one cephalad of second; spiracerores wanting.—*Ischnaspis spathulata* Lindgr.—India on *Atica*. -----*spathulata* Lindgr.

## SPECIES OF NIVEASPIIS

*Pygidium* with median pair of lobes hardly projecting, margin entire, caudal end truncated, angles rounded; each second lobe with margin more oblique, hardly projecting; plates wanting, but with spine-like projections, these projections in median and second incisurae and cephalad of third pair of lobes; preabdomen with lateral margins of segments straight, but with strong finger-like process near each caudolateral angle.—*Lepiodsaphes argentata* Ckll.—Brazil, Mexico.-----*argentata* Ckll.

## SPECIES OF FERNALDANNA

*Pygidium* with median pair of lobes minute, entire, rounded, only slightly projecting; second pair of lobes large, short and broad, much broader than long, entire, distal margin convex, each six or eight times as broad as median lobe; plates wanting; oraceratuba in each second incisura, another cephalad of each second lobe, three on each lateris cephalad of second lobe, equidistant from each other and oraceratuba adjacent to this lobe; each lateris apparently with *densariae* in which oraceratubae open; mesospiracerores 0-1.—*Fernaldella indentata* Green.—Australia. -----*indentata* Green.

## SPECIES OF MASKELLANNA

*Pygidium* with median pair of lobes minute, narrow, rounded, entire, constricted on proximal portion, very distant; second pair of lobes minute, subequal in size to median and similar in form, distant from median; plates wanting; altaceratubae arranged 1, 1, 2, 2, 1, one in median incisura; setae minute; lateres with slight projections near oraceratubae of altaceratubae, otherwise entire; dorsal oraceratubae numerous, minute, promiscuously arranged; body of adult female strongly chitinated, no differentiation between *pygidium* and other parts.—*Mytilaspis* (*Fernaldella*) *beyeriae* Green.—Australia on *Beyeria*. -----*beyeriae* Green.

## SPECIES OF PHAULOMYTIUS

*Pygidium* without lobes or plates; margin irregularly crenulate; with four small, conical, widely separated, spine-like projections arising from surface of *pygidium*; large oraceratuba located on each side of each cephalic projection; scale of female pyriform, marked with alternate transverse bands of silvery white and dark gray.—Australia on *Casuarina*. -----*striata* Mask.

## CHAPTER XXV

### TRIBE DIASPIDINI

#### *The Double-shielded Scales*

The body of the adult female is usually longer than broad, rarely broader than long, frequently two or three times as long as broad. The cephalic end is usually bluntly rounded and the caudal end is often bluntly pointed and frequently provided with a pygidial incision. The lateral margins are convex, the body is broadest through the prothorax or the first abdominal segment, and the sides usually converge caudad. The indentations marking the position of the coriae between the thoracic and abdominal segments are usually distinct. The lateral margins of the segments of the preabdomen are never provided with bractae either in the adult female or in the second nymphal female, but often with plates. Lobes are usually present, rarely entirely wanting. Plates are rarely absent, usually only in case the lobes also are wanting, pectinae are rarely present and, if present, are represented by simple furcapectinae. The incisurae, except the median, are usually narrow and filled by the plates. The median incisura is frequently a pygidial incision and is usually without plates. Densariae are never present, paraphyses are only rarely present and, when present, are not typical in form. Altaceratubae are rarely, if ever, wanting; they are arranged singly, rarely in pairs, their oraceratubae oval in outline, rarely twice as long as wide. Brevaceratubae are usually present, generally numerous, frequently arranged in interrupted transverse rows. Genacerores are usually present, usually arranged in five groups, sometimes with seven or more and sometimes with only two, three, or four groups. Mesogenacerores, when present, consisting of more than eight cerores. Scale of the adult female coriaceous or filamentous, usually whitish, sometimes grayish or brownish. Scale variable in form, either round or nearly round with the two exuviae placed just within the periphery or projecting slightly or considerably beyond it; the scale oval or pyriform or mussel-shaped in outline with the exuviae placed at one end; or greatly elongated, six or more times as long as broad, with the sides parallel. If pyriform, much longer than broad with both sides convex or with one side convex and the other concave, and with one end much smaller than the other. The two exuviae overlapping, one on the end of the other, the first exuvia bearing the remains of the antennae as porrect projections. The female is rarely enclosed in a puparium, but in a few species lives in galls and the lobes and plates may be represented by pseudolobes. The scale of the male is elongate, two or three times as long as wide, with the single exuvia projecting beyond one end. The wax is usually opaque, white, or chalky in ap-

pearance, rarely glassy and transparent. The surface is often more or less distinctly tricarinate.

There is a vague similarity about the general appearance of the species of the tribe Diaspidini by which one who is familiar with the species of the Diaspidinae is able to recognize them. This appearance is common to the scales of the adult female and of the male, the general form of the body of the adult female, the pygidium, and the pygidial fringe. While there is this similarity in appearance, yet it is too vague to define. The species that belong to the tribe Diaspidini as listed in Fernald's Catalogue are about thirty. These are distributed among nine genera.

The scale of the male is probably more typical for the tribe than that of the female. They are generally quite similar in size, shape, and appearance, elongate oval in outline with the two sides parallel or subparallel with the caudal end bluntly rounded and with the cephalic end rounded and bearing the single exuvia which projects beyond the waxy portion of the scale and bears the porrect remains of the antennae of the first nymph. The dorsal surface of the secretory portion is slightly or strongly convex and may be uniformly convex or flat and faintly or strongly carinate. The wax of the male scale is almost invariably opaque white or chalky white. This chalky white appearance of the male scales of many species is characteristic. It is a feature that is emphasized from a habit of the males of certain species. At certain times they congregate in immense numbers, in such numbers that a branch an inch in diameter for several inches or the surface of an entire leaf may be completely covered by them. The grouping together of such numbers of the chalky white scales makes the branch or leaf very conspicuous even at a considerable distance.

The scales of the adult female of the different species are very unlike in size, shape, and appearance, sometimes even among the species of the same genus. They are of four types which intergrade more or less. In most species they are pyriform with the two exuviae at the small end, the caudal and larger end is broadly rounded with the sides slightly convex and strongly divergent caudad. In a very few species the scale is very long, eight or more times as long as wide, with parallel sides. When the scale is mussel-shaped, which occurs in only a limited number of species, it is curved with one margin convex and the other concave. The surface of the mussel-shaped scales is usually more or less transversely ridged as in an oyster shell. A third type

of scale is circular or subcircular. The exuviae overlap in the circular scales just as in the pyriform scales or mussel-shaped scales, but they are frequently placed so that they do not project beyond the periphery of the scale. There may be in fact a narrow area of wax between the cephalic end of the first exuvia and the periphery or the exuviae may project very slightly beyond the periphery, only the first exuvia protruding, or the exuviae may protrude for a considerable distance, for as great a distance as in the pyriform scales. In the location of the exuviae, even in different individuals of the same species, there may be considerable variation, sometimes being placed parallel or nearly so with the margin and at others perpendicular to it. When the exuviae project a considerable distance beyond the periphery of the scale, the wax of the scale adjacent to the exuviae is sometimes extended so that the scale becomes slightly prolonged and approaches the pyriform type. The scales, while they are more often white than any other color, are often grayish or blackish, particularly in the genus *Chionaspis*. The texture of the scale in many species as in those of the genus *Diaspis* and its allies is very thin, semi-transparent, tough, and parchment-like. In the darker colored mussel-shaped scales, they are more coriaceous and leathery like the scales of the genus *Lepidosaphes*. The exuviae overlap each other and the first nymph bears the remains of the antennae as porrect projections. The exuvia of the second nymph is about three or four times as long as that of the first. It is always much less in extent than that of the wax of the scale, covering one-fourth or less of the area of the scale. Only a very few of the species transform in a puparium which explains why the second exuvia is generally not very large. The ventral scale is extremely variable in extent and texture, it may be very thin and delicate and remain attached to the host-plant when the dorsal scale is lifted or it may be stout and thick and retain its connection with the dorsal scale when removed.

The scales of certain species of *Chionaspis* resemble closely the scales of most of the species of *Lepidosaphes*, some individuals resembling them so closely that it is necessary to examine the body of the female to be sure of their correct generic position. The Latin word *aspis* from which so many of the generic names in this subfamily are compounded means a shield. This may have been applied originally to the scale as a whole, but evidently in the case of the generic name *Diaspis* from which the name of this subfamily and tribe is derived, refers to the exuviae of

which there are two. The word *Diaspis* would mean literally then two shields and since the genus is the typical one of the tribe, the common name of The Double-shielded Scales has been applied to them. The name of a subfamily and tribe according to rule is derived from the stem of the genitive which in the case of *Diaspis* is *Diaspidis*, hence, the proper form for the names of these groups is *Diaspidinae* and *Diaspidini* and not *Diaspinae* and *Diaspini* as they are generally written.

The body like the scale varies considerably in size. Where the scale is pyriform, mussel-shaped, or elongate, the body if elongate, is usually two to four times as long as broad; but in those species with a circular scale, the body is shorter and broader and the greatest width is through the thoracic region which is always much wider than the preabdomen. In dried specimens the segments of the preabdomen are crescentic and retracted into the caudal part of the thorax. The pygidium in turn is retracted into the caudal end of the preabdomen so that the preabdomen and the pygidium seem to constitute only a small portion of the area of the body. The cephalic part of each lateral margin of the thorax sometimes bears a short bluntly rounded tubercle. In those species with elongate bodies the preabdomen and pygidium are larger and constitute, even in dried retracted individuals, a much larger and more prominent portion of the body. The cephalic end of the body is usually broad and convexly rounded. The width of the cephalic end varies with the species, in some it is the broadest part of the body while in others it may be only one-half or less of the greatest width. The body, while it is always depressed, is never decidedly flattened as in some other tribes of *Diaspidinae*. The antennae are usually represented by minute distant tubercles bearing one to three stout setae.

The preabdomen is generally distinctly segmented and easily distinguished from the thorax and pygidium. The segments are separated by deep constrictions marking the position of the coriae. The portions of the segments between the coriae are generally strongly convex, which generally emphasizes the depth of the coriae. The lateral margins of the segments, particularly the caudal ones, are frequently provided with plates or short blunt plate-like projections, but never with bracteae.

The pygidium is comparatively large and well differentiated. It is usually circular or oval in outline, both the cephalic and the

caudal margins are convex. The lateral margins are slightly convex and are rarely if ever almost straight and converge caudad. The mesal part of the caudal margin of the pygidium in a number of species is concave or emarginate and provided with a pygidial incision. This is variously described as a deep median cleft or the pygidium as semicircularly hollowed out.

The lobes vary in number as in the other tribes. There are typically about three pairs, the median pair is always the largest. The second or third pairs may be divided into two or three lobets or deeply incised. When the caudal margin of the pygidium is concave or provided with a pygidial incision, the first pair of lobes is usually located in the concavity, oblique in position and the greater part of their lateral margin is continuous with or fused to the pygidium. Their mesal margins, which are usually convexly rounded and continuous with the rounded distal ends, are usually finely serrate or crenulate. Where the median pair of lobes is free on the lateral margin, their distal ends are usually notched. In certain species the proximal ends of the median lobes are fused, in others their mesal margins are straight and adjacent, the two lobes appearing to form a single semicircular area, while in others the adjacent mesal margins have fused until there is only a notch on the meson marking their point of separation. The margins of the second and third pairs of lobes may be serrate, crenulate, or notched, if notched, the number and distinctness of the notches vary with the species. In a few species all the lobes have been lost and the margin of the pygidium is entire, in some others pseudolobes which are very lobe-like in appearance have replaced the true lobes.

The plates are only rarely wanting except in the median incisura where they are only rarely present. They are usually long and slender, as long as or longer than the lobes, spine-like in form, with lamaceratubae opening in their pointed ends. The plates are usually arranged, 0, 2, 2, 2, 2, or 0, 1, 1, 1, 2. There is not much variation in the number in the different incisurae and on the lateris. The plates are in extreme cases represented by apically furcate furcapectinae. The group of four or five plates near the cephalic end of the pygidium is located on the caudal segment of the preabdomen.

The altaceratubae are prominent, large with comparatively long tubes. They are generally located singly but in some species

there are two adjacent ones in each third or third and fourth incisura. They are never as large as those of the *Lepidosaphini* and their *oraceratubae* are generally shorter and more nearly circular in outline. The *oraceratubae* are generally located in *latadentes*. The presence of *latadentes* seems to be quite constant for all the species.

The *brevaceratubae* are more prominent and more numerous in many of the species of this tribe than in the species of other tribes. In some species their *oraceratubae* are irregularly distributed over the dorsal surface while in others they are arranged in crescentic or semicircular transverse rows. Where the *brevaceratubae* are arranged in rows, each row usually consists of a single line of *oraceratubae*, but the row may consist of two or three lines or of a number of *oraceratubae* irregularly arranged, forming a broad band. The rows are always so far as observed interrupted on the meson, forming right and left halves. The halves of the rows in many species are also interrupted near the middle of each lateral half so that each complete crescentic transverse row is generally subdivided into four parts or groups. The crescentic rows of *oraceratubae* are located on lines connecting the median lobes, the second incisurae, the third incisurae, the fourth incisurae, the fifth incisurae, and the cephalic margin of the pygidium. The lines connecting the points named on the two sides of the pygidium extend cephalad in each case around the anus. Green has recognized six of these lines as present, while Cooley identifies only five. Both Green and Cooley including Morgan consider the lines of *oraceratubae* as indicating, at least approximately, the lines of the suppressed segments of the pygidium. These authors differ, however, somewhat as to the way in which these lines should be traced. Green considers the rows of *oraceratubae* as marking the posterior or caudal border of the segment and it would seem as if there was evidence for his conclusion. The lines or rows of *oraceratubae* are numbered on each side, beginning at the meson, as the first, second, third, fourth, fifth, and sixth rows. In order to be able to distinguish between the two groups of each half row, the group near the meson may be known as a mesal group, the anterior group of Cooley, and the group near the margin of the pygidium as the lateral group, the posterior group of Cooley. There are rarely *oraceratubae* present in the first row. They are also of rare occurrence in the second row, if present, they are only represented by a mesal group or a lateral group. The other rows are gener-

ally represented by both mesal and lateral groups, sometimes by only a single group, mesal or lateral. There is considerable variation in the number of oraceratubae in the various groups in different species and some use has been made of this difference in number in differentiating species.

The lamaceratubae are never very prominent in the pygidia of this tribe. They are slender and extend through each plate, their oraceratubae located at the distal end, as in the plates found in the pygidia of other species.

The vulva is a transverse slit, which is usually located near a transverse line drawn through the pregenacerores and postgenacerores, that is, it is approximately central in position. There is a slight variation from this position, in some it is a short distance cephalad and in others a short distance caudad of this line.

While the vulva is fairly constant in position, the anus seems always to be extremely variable. It may be located caudad of a line drawn through the caudal margin of the postgenacerores or in the cephalic portion of the pygidium, usually cephalad of a line drawn through the cephalic ends of the pregenacerores or it may be located anywhere between these lines. In a number of species it is superimposed over the vulva.

The vulva is typically surrounded by five groups of genacerores. In a few genera the number may be increased to seven or more groups. The number of cerores in each group is variable. There is usually about eight mesogenacerores, the number varying from two to thirty or more. The groups of pregenacerores may contain a few cerores, twelve or a large number, sixty. There is also considerable variation among the postgenacerores, the number varying from one to forty. The mesogenacerores are sometimes wanting and in several genera all the genacerores are wanting. Green records the presence of two more or less definite glandular scars. These are reticulate and located cephalo-laterad of each group of pregenacerores. They are considered as homologous with the groups of genacerores, in fact he describes the occurrence of cerores in one of these glandular scars.

The marginal setae of the pygidium are frequently comparatively short and stout, so that they extend as rigid projections and, for this reason, are easily mistaken for plates and have been described as such. This is particularly true of the two prominent setae located in the median incisura. These setae instead of being located on the dorsal side of the median pair



of lobes as is usual are located between and project between the lobes as rigid extensions or like plates.

The parts of the pygidial fringe that in this tribe occur with only rare exception are beginning at the meson arranged in the following order. There is a well marked median incisura sometimes containing one or two latadentes, usually without plates, and bounded on each side by a median lobe. The second *incisura cephalad* of each median lobe contains a latadentis and one or two plates. This incisura is limited by a second lobe. The third incisura also contains a latadentis and one or two plates and is limited by a third lobe. The fourth pair of lobes may be present but is only rarely so and the area cephalad of the third lobe belongs to a lateris and usually bears four groups of plates, the groups usually separated by latadentes. The fourth or cephalic group generally contains more plates than the others.

The genera and species of this tribe are difficult to separate. Many of the structures available in the other tribes for separating genera and species are not available here. Some writers have not always been careful to differentiate the characters present so that it is sometimes difficult to decide whether a given species has lobes, plates, or what is more likely latadentes bearing oracratubae.

The following species have been omitted from the tables, either because the description was not available or because it was not possible to place the species:—*Chionaspis bambusae* Ckll. from Japan on bamboo; *depressa* Zehnt. from E. Java on *Saccharum*; *myrthi* Bouche from France on *Myrtus*; *natalensis* Mask. from Natal on grass; *nitida* Mask. from Australia on *Daviesia*; *planchonii* Sign. from southern Europe on *Quercus*; *rosae Goethe* from Germany; *sacchari-folii* Zehnt. from Java on sugar cane; *tegalensis* Zehnt. from Java, Mauritius; *Diaspis blankenhorni* Targ from Italy; *celtidis* Ckll. from Texas on *Celtis*; *chilensis* Ckll. from Chili; *colvei* Penzig from Italy; *cordiae* Rubs. from Brazil on *Cordia*; *euphoriae* Charm. from Mauritius on *Nephellum*; *minima* Targ. from Europe on *arbor-vitae*; *monserati* Colv. from Spain on *Corynocarpus*(?); *olea* Colvee from Spain on olive; *sentali* Mask from New Zealand on *Santalum*, pear, plum; *squamosus* Newst. & Theobald from Egypt on peach, pear; *taxicola* Vays. from Algeria on *Taxus*; *trinacis* Colvee from Spain on *Trinax*, *Strelitzia*; *vici* Schr. from Europe on mistletoe; *Aspidiotus* (*Diaspis*) *vitiensis* Mask. (Leon.) from Fiji; *Epidiaspis subterranea* Lindgr. from France on grass, evidently an aspidiotid; *Pollaspis casuarinae* Lidg. from Australia on *Casuarina*; *Pseudoparlatoria ostreata* Ckll. from Jamaica on *Acalypha*. The tables offered for separating the genera and species should be used with care and wherever possible specimens should be compared with the original descriptions and figures.

GENERA OF DIASPIDINI

- a. Pygidium always with one or more groups of genacerores.
- b. Female never transforming in puparium; scale rarely without distinct second exuvia.
- c. Pygidium never with more than five groups of genacerores.
- d. Pygidium always with four or five groups of genacerores.
- e. Pygidium always with plates in median incisura.
  - f. Pygidium with plates of median incisura separate, proximal ends, even if adjacent, not fused and never forming fish-tail-shaped projection.
  - g. Pygidium with two or three pairs of lobes, second pair incised; genacerores in five groups.—Type, *Diaspis juniperi* Bouche.....*Carulaspis* MacG.
  - gg. Pygidium with series of fifteen or more pairs of lobe-like projections or latadentes; genacerores in four groups. ....*Diaspidistis* Hemp.
  - ff. Pygidium with pair of plates in median incisura adjacent and fused at proximal end and with distal portions divergent, forming fish-tail-shaped projection.....*Pseudoparlatoria* Ckll.
- ee. Pygidium never with plates in median incisura, frequently with pair of large setae that are plate-like in appearance.
- f. Scale of adult female round or oval with exuviae usually located just within or projecting slightly beyond the periphery of the scale.
- g. Pygidium with plates in incisurae or on lateres or on both.
- h. Pygidium with median pair of lobes, even if adjacent, never fused.
- i. Pygidium with rounded latadentes or plates in incisurae other than median, never with truncate lobe-like projections.
- j. Pygidium with oraceratubae of brevaceratubae arranged in crescentic transverse rows.
- k. Pygidium with caudal margin convex, never concave with median pair of lobes placed in concavity.—Type, *Aulacaspis pentagona* Targ.....*Pseudaulacaspis* MacG.
- kk. Pygidium with caudal margin deeply concave on meson, forming pygidial incision with median pair of lobes located in concavity. ....*Aulacaspis* Ckll.
- jj. Pygidium with oracertubae of brevaceratubae arranged promiscuously, never in crescentic transverse rows.

- k. Pygidium with caudal margin convex, never concave with median pair of lobes located in concavity; brevaceratubae always few in number.
  - l. Pygidium with anus located about its own width from vulva, distant from caudal margin. -----*Epidiaspis* Ckll.
  - ll. Pygidium with anus located about midway between vulva and caudal margin.-- Type, *Diaspis montana* Ckll.-----  
*Cockercillaspis* MacG.
- kk. Pygidium with caudal margin deeply concave on meson with median pair of lobes in concavity; brevaceratubae usually numerous; anus located nearly midway between vulva and caudal margin than to vulva. -----*Diaspis* Costa.
- ii. Pygidium with truncate lobe-like projections located in incisurae other than median.--Type, *Diaspis regularis* Newst.-----*Umbaspis* MacG.
- hh. Pygidium with median pair of lobes fused into single arca.--Type, *Chionaspis malloti* Ruth.-----  
*Rutherfordia*\* MacG.
- gg. Pygidium without plates in incisurae or on lateres.
  - h. Pygidium with two pairs of lobes, five groups of genacerores, anus located near caudal margin, and large altaceratubae.-----*Protargionia* Leon.
  - hh. Pygidium without lobes, genacerores forming U-shaped group, anus located distant from caudal margin, and altaceratubae small or wanting.--Type, *Protodiaspis agrifoliae* Essig.----*Essigaspis* MacG.
- ff. Scale of adult female never circular, always pyriform, mussel-shaped, mytilaspiform, or linear, twice or more as long as wide, rarely with poorly defined scale and living in gall.
- g. Insects always living exposed, never producing abnormal growths or galls upon plants.
  - h. Pygidium of adult female always with plates in incisurae or on lateres.
    - i. Pygidium with caudal margin convex, never with deep angular or semicircular pygidial incision.
    - j. Pygidium with mesal margins of median pair of lobes convexly rounded and divergent, if straight, two margins usually distant, if straight and adjacent, proximal ends fused,

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\*This genus is named for my former student, the late Andrew Rutherford, who died from enteric fever while in service as Government Entomologist of Ceylon.

two lobes together never forming single compact semicircular area.

- k. Pygidium with median pair of lobes normal in form, never minute and plate-like.
- l. Pygidium with oraceratubae of brevaceratubae arranged in crescentic transverse rows, sometimes few in number.
- m. Pygidium with rows of oraceratubae of brevaceratubae of each side of meson divided into two prominent subgroups.
- n. Pygidium with median pair of lobes sometimes adjacent, but never fused.
- o. Pygidium with three or four pairs of lobes.
  - p. Pygidium with four pairs of lobes.—Type, *Chionaspis laniger* Newst.—*Sclopetaspis* MacG.
  - pp. Pygidium with three pairs of lobes. -----*Chionaspis* Sign.
- oo. Pygidium with one or two pairs of lobes.
  - p. Pygidium with two pairs of lobes.—Type, *Chionaspis graminis* Green.-----  
*Duplachionaspis* MacG.
  - pp. Pygidium with one pair of lobes.—Type, *Chionaspis colemani* Knw.-----  
*Unachionaspis* MacG.
- nn. Pygidium with median pair of lobes fused on proximal portion, remainder of lobes divergent or adjacent, rarely completely fused; combined lobes not semicircular.
  - o. Pygidium with three pairs of lobes.—Type, *Chionaspis americana* Johns. -----*Fundaspis* MacG.
- oo. Pygidium with one pair of lobes.—Type, *Diaspis chionaspiformis* Newst. -----*Africaspis* MacG.
- mm. Pygidium with rows of oraceratubae of brevaceratubae few in number and not divided into two subgroups.
- n. Body with head and thorax together distinctly more than twice as long as abdomen.—Type, *Chionaspis elongata* Green.----*Greenaspis* MacG.

- nn. Body with head and thorax not abnormal in length, together only slightly longer than abdomen.—Type, *Chionaspis minuta* Green.-----  
*Tenuiaspis* MacG.
- ll. Pygidium with craceratubae of brevaceratubae arranged promiscuously, never in crescentic transverse rows.—Type, *Chionaspis acuminata* Green.-----  
*Unaspis* MacG.
- kk. Pygidium with median pair of lobes minute and plate-like, second pair of lobes large and apparently with six plates between them.—Type, *Chionaspis striata* Newst.-----  
*Lincaspis* MacG.
- jj. Pygidium with mesal margins of median pair of lobes straight and adjacent, rarely if ever fused, two lobes together always forming single compact semicircular area.-----  
*Hemichionaspis* Ckll.
- ii. Pygidium with caudal margin deeply concave, forming deep angular or semicircular pygidial incision.
- j. Pygidium with median pair of lobes located within pygidial incision.
- k. Body with preabdomen symmetrical, dextral and sinistral margins of segments similar, if bearing setae on spine-like projections, these confined to thorax and located on both sides.
- l. Body with thorax at most never twice as long as wide, varying from as wide as long to one and one-half times as long as wide.
- m. Thorax normal, not bearing one or two small tubercle-like bracteae with ceratubae on mesothorax and metathorax, mesospiracerores usually present. -----*Phenacaspis* Ckll.
- mm. Thorax bearing one or two small conical tubercle-like bracteae with ceratubae on mesothorax and metathorax; mesospiracerores wanting.—Type, *Chionaspis arundinariae* Green.-----  
*Canaspis* MacG.
- ll. Body with thorax with parallel sides and two and one-half times as long as wide.—Type, *Chionaspis praelonga* Newst.-----  
*Cooleyaspis* MacG.

- kk. Body with preabdomen asymmetrical, sinistral margin of four segments of preabdomen bearing large spine-like setae on tubercle-like swellings of margin, wanting dextral margin.—Type, *Chionaspis unilateralis* Newst. -----*Sinistraspis* MacG.
- jj. Pygidium with median pair of lobes located on ends of projections forming lateral limits of pygidial incision.—Type, *Chionaspis nudata* Newst. -----*Augulaspis* MacG.
- hh. Pygidium of adult female always without plates.
  - i. Pygidium always with one or more pairs of distinct lobes.
    - j. Pygidium with three pairs of lobes.—Type, *Chionaspis africana* Newst.-----*Gramenaspis* MacG.
    - jj. Pygidium with one pair of lobes.—Type, *Chionaspis subnudata* Newst.---*Contigaspis* MacG.
    - ii. Pygidium without lobes, margins undulate.—Type, *Chionaspis simplex* Brain-----*Natalaspis* MacG.
  - gg. Insects always living in abnormal growths or galls upon plants; scale of adult female lining cavity of gall, exuviae placed in orifice of gall or wanting; pygidium of adult female with triangular, median, lobe-like projection.—Type, *Chionaspis galliformens* Green. -----*Parachionaspis* MacG.
- dd. Pygidium with a single transverse group of genacerores.----*Parlatorcopsis* Lindgr.
- cc. Pygidium always with more than five groups of genacerores, seven or more.
  - d. Pygidium with oraceratubae of brevaceratubae arranged in crescentic transverse rows; with at least one pair of lobes; scale of adult female pyriform, of male not carinated.-----*Poliaspis* Mask.
  - dd. Pygidium with oraceratubae of brevaceratubae promiscuously arranged, not in rows; lobes wanting.—Type, *Chionaspis simplex* Green. -----*Poliaspoides* MacG.
- bb. Female always transforming in puparium; scale of adult female not with second exuvia.
  - c. Pygidium of adult female with plates between median pair of lobes. -----*Cryptaspidus* Lindgr.
  - cc. Pygidium of adult female never with plates between median pair of lobes, with deep pygidial incision with oblique distant lobes. -----*Cryptodiaspis* Lindgr.
- aa. Pygidium always without groups of genacerores.

- b. Body of adult female never enclosed in puparium; scale of adult female usually with second exuvia.
- c. Pygidium with plates or pectinae cephalad of median pair of lobes.
- d. Body never with deep transverse constriction.
- e. Pygidium of adult female always without paraphyses.
- f. Pygidium with furcapectinae or plates in median incisura.
  - g. Pygidium with furcapectinae in median, second, and third incisurae; caudal margin with pygidial incision.—Type, *Diaspis zamiae* Morg. *Furchadaspis* MacG.
  - gg. Pygidium with plates in median, second, and third incisurae; caudal margin convex, not with pygidial incision.—Type, *Chionaspis funtumiae* Newst.-----  
*Mitulaspidis* MacG.
- ff. Pygidium without furcapectinae or plates in median incisura.
  - g. Pygidium with furcapectinae on lateres; median pair of lobes incised and smaller than second pair.—Type, *Chionaspis capensis* Newst.----*Dentachionaspis* MacG.
  - gg. Pygidium never with furcapectinae on lateres; median pair of lobes never incised.
  - h. Body with rostrum normal in position, distant from cephalic margin.
  - i. Body with rudimentary antennae normal in form, consisting of minute projection bearing one to three setae, never located on chitinated area bearing corona of four to six spine-like projections.
  - j. Pygidium with three or four pairs of lobes; scale usually elongate.
  - k. Pygidium with four pairs of lobes; caudal margin with distinct pygidial incision; median pair of lobes rudimentary.—Type, *Chionaspis amaniensis* Lindgr.-----  
*Inchoaspis* MacG.
  - kk. Pygidium with three pairs of lobes; median pair of lobes always distinct.
  - l. Pygidium with anus and vulva superimposed.
  - m. Pygidium with caudal end truncate or convex; median pair of lobes distant and strongly divergent caudad.—Type, *Chionaspis permutans* Green.-----  
*Graphaspis* MacG.

- mm. Pygidium with caudal margin with deep pygidial incision, median pair of lobes located in incision and not or scarcely projecting beyond its sides.—Type, *Chionaspis flava* Green.-----  
*Ametrochaspis* MacG.
- 11. Pygidium with anus distinctly farther caudad than vulva.
  - m. Pygidium with caudal margin with deep pygidial incision; each median lobe as large as or larger than mesal lobelet of second lobe; median pair of lobes subadjacent.—Type, *Chionaspis citri* Comst. -----*Prontaspis* MacG.
  - mm. Pygidium with caudal margin convex; each median lobe distinctly smaller than mesal lobelet of second lobe; median pair of lobes distinctly farther apart than width of median lobe.—Type, *Chionaspis dentilobis* Newst.-----  
*Remotaspis* MacG.
- jj. Pygidium with one or two pairs of lobes.
  - k. Pygidium with two pairs of lobes.
    - l. Pygidium with anus located distinctly cephalad of vulva, near cephalic margin.
    - m. Pygidium with two pairs of large prominent lobes; oraceratubae of brevaceratubae in rows.—Type, *Chionaspis distorta* Newst.-----  
*Asymmetraspis* MacG.
    - mm. Pygidium with two pairs of minute inconspicuous lobes; oraceratubae of brevaceratubae not in rows, promiscuously arranged.—Type, *Protodiaspis lobata* Ferris.-----*Obluctaspis* MacG.
  - 11. Pygidium with anus located distinctly caudad of vulva, near caudal margin.—Type, *Pseudodiaspis condaliae* Ferris.-----  
*Situlaspis* MacG.
- kk. Pygidium with single pair of lobes.
  - l. Pygidium with caudal margin uniformly convex.—Type, *Chionaspis* (?) *hikosani* Kuwn. -----*Kucanaspis* MacG.
  - 11. Pygidium with caudal margin with distinct pygidial incision.—Type, *Diaspis pugionifera* Lindgr.-----*Inciaspis* MacG.



- ii. Body with rudimentary antennae borne on circular strongly chitinized area fringed with four to six stout spine-like projections.—Type, *Chionaspis coronifera* Green...*Coronaspsis* MacG.
- hh. Body with rostrum abnormal in position, located quite close to cephalic margin.—Type, *Chionaspis substriata* Newst. ....*Dentaspis* MacG.
- ee. Pygidium with at least one pair of paraphyses.
  - f. Thorax usually wider than long, never four times as long as wide; two plates in median incisura.....  
*Howardia* Leon.
  - ff. Thorax four or more times as long as wide; plates wanting in median incisura.—Type, *Chionaspis cinnamomi* Green. ....*Proceraspis* MacG.
- dd. Body of adult female with deep transverse constriction between mesothorax and metathorax.—Type, *Chionaspis vulletti* Marchal. ....*Marchalaspis* MacG.
- cc. Pygidium never with plates cephalad of median pair of lobes.
  - d. Pygidium with at least one pair of distinct lobes, never with pseudolobes.
    - e. Pygidium with caudal margin convex, not with pygidial incision.
      - f. Pygidium with anus located distinctly cephalad of middle of pygidium, near its cephalic end.—*Leucaspis cupressi* Colem.....*Cupidaspis* MacG.
      - ff. Pygidium with anus located distinctly caudad of middle of pygidium, near its caudal margin...*Pseudodiaspis* Ckll.
  - ee. Pygidium with deep angular pygidial incision, median pair of lobes inserted in incision.—Type, *Chionaspis (Dinaspis) diosmae* Brain. ....*Versiculaspis* MacG.
- dd. Pygidium with caudal margin either entirely without lobes or with serrate or dentate pseudolobes.
  - e. Pygidium with anus located distinctly cephalad of middle of pygidium, near its cephalic end.
    - f. Pygidium with caudal margin entire, without lobes or pseudolobes; insects never producing galls upon plants.  
*Protodiaspis* Ckll.
    - ff. Pygidium with caudal margin with pseudolobes, six or seven subequal serrate pairs; insects producing galls upon leaves of plants.—Type, *Chionaspis fodiens* Green...  
*Nudachaspis* MacG.
- ee. Pygidium with anus located distinctly caudad of middle of pygidium; three pairs of lobe-like projections with setae at their distal end; lobe-like projections and lateres distinctly continuously crenulate; insects living exposed, never producing galls. ....*Xanthophthalmus* Ckll. & Parr.

- bb. Scale of adult female never with a second exuvia; body always enclosed in a puparium.
- c. Pygidium of adult female with single pair of distinct lobes.—  
Type, *Diaspis* (*Cryptodiaspis*) *limuloides* Lindgr.-----  
*Credodiaspis* MacG.
- cc. Pygidium of adult female without lobes.—*Adiscodiaspis* Marchal.

SPECIES OF CARULASPIS

- a. Pygidium of adult female with two pairs of lobes; caudal margin truncately rounded; median pair of lobes with distal end rounded, entire or slightly notched; second pair of lobes incised, mesal lobelet much larger than lateral, entire; plates stout, slightly longer than lobes, arranged 2, 2, 7, those of each lateris arranged 1-1-2-3; latadentes of each second incisura triangular and as long as lobes, two adjacent to plate at cephalic margin of second pair of lobes, rounded, with oraceratubae; genacerores 5-8(10-16)7-9; mesospiracerores usually two.—*Diaspis carueli* Targ., *Diaspis juniperi* Bouche.—Italy, England, New York, Massachusetts, District of Columbia on *Juniperus, arbor-vitae*.-----*juniperi* Bouche.
- aa. Pygidium of adult female with three pairs of lobes.
  - b. Pygidium with third pair of lobes incised.
    - c. Pygidium with lobes all entire; median pair of lobes broader than long, indistinct mesal and lateral notches, bluntly pointed between notches; second and third pairs of lobes incised, lobelets subequal in size and similar in form to lobelets of second pair; plates slender, arranged 2, 1, 1, 4, those of each lateris arranged 1-1-1-1; lateres irregularly broadly indented, crenulate; latadentes bearing oraceratubae in second and third incisurae; genacerores in four groups.—*Pseudoparlatoria cristata* Lindgr.—Brazil on *Gnetum*.-----*cristata* Lindgr.
    - cc. Pygidium with third pair of lobes minutely serrate, wide apart, striated, produced, but not conspicuously beyond margin; second and third pairs of lobes incised; plates spine-like, arranged 2, 1-2, 1-2, 5, those of lateres arranged 1-1-1-1-1; latadentes caudad of each second and third lobe and two cephalad of third pair of lobes representing fourth pair of lobes; genacerores 11-11(18-18)8-8.—*Diaspis miranda* Ckll.—Mexico on "*Cherimoya*," "*Zapote*."-----*miranda* Ckll.
  - bb. Pygidium with third pair of lobes not incised, rounded; lateral margin oblique, intermediate in size between lobelets of second pair of lobes; mesal lobelet of second pair of lobes nearly twice as large as lateral, bluntly rounded, lateral irregularly rounded; median pair of lobes slightly larger than mesal lobelet of second pair, bluntly rounded; lobes all entire; plates longer than lobes, arranged 2, 1, 1, 4, those of each lateris arranged 0-1-2-1; lateres crenulate and irregularly finely notched; latadentes large in second incisurae, smaller in third; anus superimposed over vulva; genacerores 5-7(14-21)20-25; mesospiracerores 2-1, metaspiracerores 2.—*Pseudoparlatoria chilina* Lindgr.—Chile on *Saxegothaea, Podocarpus*.-----*chilina* Lindgr.

## SPECIES OF DIASPIDISTIS

*Pygidium* of adult female with median pair of lobes largest, crenulate; second and third pairs of lobes incised, lobelets subequal, crenulate; fourth pair of lobes deeply incised into five subequal crenulate lobelets; each lateris with seven or eight subequal projections or latadentes; plates arranged 2, 1, 1, 0; second, third, and fourth incisurae with broad lobe-like latadentes bearing oracratuba; genacerores (15-28) 28-27.—Brazil on Myrtaceae.-----*multilobia* Hemp.

## SPECIES OF PSEUDOPARLATORIA

- a. *Pygidium* of adult female with median pair of lobes rounded, minutely serrate, not notched; second pair of lobes divided into three lobelets; plates of median incisura hardly projecting beyond lobes; genacerores 2-2 (12-15) 11-15.—Mexico on Myrtus.-----*serrulata* Towns. & Ckll.
- aa. *Pygidium* with median pair of lobes not serrulate.
  - b. *Pygidium* with five groups of genacerores, 7-7 (20-20) 16-18; median pair of lobes rounded at distal end, sides sloping, subbasal notches wanting; second and third pairs of lobes incised; plates of median incisura subparallel, longer than lobes.—Brazil on *Nectandra*.-----*noacki* Ckll.
  - bb. *Pygidium* usually with four groups of genacerores, 0-2 (9-15) 7-10; median pair of lobes quadrangular, deep mesal and lateral notches; second and third pairs of lobes similar, incised, mesal lobelet largest, lobelets triangular, bluntly pointed, often with lateral notch; plates arranged 2, 1, 1, 0, those of median incisura subequal to lobes, those of other incisurae longer than lobes; each lateris with four slight projections, arranged in pairs, caudal pair distant from third lobe; anus midway between vulva and caudal margin, about three times its width from each.—Florida, Mexico, Brazil on *Persea*, *Drimys*, *Psidium*, *Oncidium*, *Magnolia*, peach.-----*parlatoroides* Comst.

## SPECIES OF PSEUDAULACASPIS

- a. *Pygidium* always with two or more pairs of distinct lobes, median pair large and prominent, second pair always small.
- b. *Pygidium* with more than two pairs of lobes.
- c. *Pygidium* with second and third pairs of lobes incised.
  - d. *Pygidium* with median pair of lobes rounded, radially striate, moderately large, margins irregularly crenulate; second pair of lobes consisting of two large subequal lobelets; third pair of lobes consisting of two lobelets, mesal smallest; fourth pair of lobes consisting of two very broad, low lobelets, mesal low and conical, lateral gently convex and serrate with five teeth; fifth pair of lobes represented by two broad low processes; plates arranged 0, 1, 1, 1, 0, 0; most of described lobes probably latadentes; latadentes of each second and third incisurae as large as mesal lobelet, of each third incisura smaller; genacerores 29-30 (49-58) 21-31.—China, Japan on *Eleagnus*.-----*crawii* Ckll.

- dd. Pygidium with median pair of lobes with mesal margins long and straight near proximal end, broadly rounded, finely crenulate; second pair of lobes incised, mesal lobelet larger than lateral, distal end of mesal lobelet rounded, of lateral lobelet pointed; third pair of lobes similar to second, smaller; plates long and slender, much longer than lobes, arranged 0, 1, 1, 8, those of second incisurae furcapectinae, those of each lateris arranged 1-7; genacerores 27-31(55-57)31-39.—Natal on *Melia*, *Ricinus*.-----*fulleri* Ckll.
- cc. Pygidium with none of lobes incised; median pair of lobes distant, broadly rounded, entire; second and third pairs of lobes subquadrangular, margins substraight, distal ends serrate; fourth pair of lobes smaller, subquadrangular, angles of distal end prolonged, spine-like; plates slightly longer than lobes, arranged 0, 0, 0, 3, 6, those of each lateris arranged 3-3; anus located caudad of vulva near caudal margin; setae as long as lobes; genacerores 8-8(17-20)9-10.—Greece on *Pistacia*.---*gennadii* Leon.
- bb. Pygidium with two pairs of lobes.
  - c. Pygidium with median pair of lobes with proximal end distinctly wider than distal, never constricted on proximal portion.
  - d. Pygidium with second pair of lobes short, distinct, incised.
    - e. Pygidium with genacerores 6-25(14-46)12-38.
      - f. Pygidium with second pair of lobes small, incised, mesal lobelet twice or more as long as lateral lobelet; median pair of lobes much larger, subtriangular, both margins crenulate, distal end entire or margins rarely subentire and notched; each lateris with two groups of bluntly rounded or toothed latadentes, each with an oraceratuba; minute latadentes in each second incisura; plates of furcapectinae arranged 0, 1, 10-12, those of each lateris arranged 1 or 2-3-6; anus and vulva superimposed; genacerores 6-25(14-46)12-38; mesospiracerores 15-17.—Europe, south eastern United States, West Indies, Mexico, South America, China, Japan, India, south Africa, Ceylon, New Zealand, Australia, etc. on peach, plum, prune, cherry, apricot, walnut, grape, persimmon, geranium, etc. -----*pentagona* Targ.
      - ff. Pygidium with second pair of lobes doubly incised, median lobelet much longer than mesal or lateral; plates long, one in each second incisura, two cephalad of each second lobe, about fourteen on each lateris; genacerores 9-9(26-26)16-19.—Japan, California on *Osmanthus*.-----*pentagona auranticolor* Ckll.
    - ee. Pygidium with genacerores 76-76(51-51)40-50; median pair of lobes well developed, triangular, rounded at distal end, slightly serrate; second pair of lobes only slightly developed; plates strong, arranged 0, 1, 12-14, those of each lateris arranged 1-2-4-6-6-7; brevaceratubae arranged in

- two transverse interrupted rows; latadentes small; meso-spiracerores present, metaspiracerores wanting.—Ceylon on *Flacourtia*. ----- *flacourtiæ* Ruth.
- dd. Pygidium with second pair of lobes obscure, rounded, not incised; median pair of lobes extremely large, widely separated, strongly divergent, rounded, finely crenulate; plates arranged 0, 0, 12, those of each lateris arranged 2-1-1-2-1-1-1; anus five times its width from caudal margin and over six times from vulva; genacerores 24-24 (36-36) 25-25.—Arizona on *Holocantha*. ----- *toumeyii* Ckll.
- cc. Pygidium with median pair of lobes prominent, divergent, broadly flabelliform, constricted on proximal portion, broadly rounded and slightly and irregularly notched; second pair of lobes incised, mesal lobelet prominent, slightly dilated toward extremity, truncately rounded, lateral lobelet triangular, much shorter than mesal; plates short on caudal and long on cephalic portion of pygidium, arranged 0, 1, 10, those of each lateris arranged 1-2-2-(2-2); anus and vulva probably near together; genacerores 6-9 (18-23) 19-23; dorsal oraceratubae large, numerous, conspicuous.—India on *Loranthus*. ----- *barberi* Green.
- aa. Pygidium with single pair of distinct, not particularly large lobes, edges slightly crenulate, lobes almost adjacent at proximal end; second pair of lobes represented by pair of minute tubercles; three furcapectinae in each second incisura and about twelve on each lateris; genacerores 25-25 (15-15) 7-12.—Mexico on "*Chico Sapote*."----- *perstimilis* Ckll.

## SPECIES OF AULACASPIS

- a. Body oval or trigonal in outline, cephalic and lateral margins forming continuous broadly rounded curve.
- b. Pygidium with vulva and anus superimposed.
- c. Pygidium with plates or furcapectinae of second and third incisurae projecting almost their entire length caudad of caudal ends of median pair of lobes.
- d. Pygidium with seven pairs of altaceratubae.
- e. Pygidium with median pair of lobes serrate and with plates in incisurae cephalad of median pair of lobes.
- f. Pygidium with three continuous series of brevaceratubae; median pair of lobes long, widely divergent, finely serrate, proximal ends almost adjacent; second and third pairs of lobes subequal, incised; plates large and spine-like, arranged 0, 1, 1, 4, those of each lateris arranged 1-1-1-1; genacerores 11-33 (17-40) 14-40; meso-spiracerores 8-12, metaspiracerores 4-6.—Europe, Australia, Japan, Hawaiian Islands, Chile, West Indies, eastern United States, Canada, California on rose, raspberry, strawberry, blackberry, pear, myrtle, *Althaus*, *Cycas*, mango, etc. ----- *rosæ* Bouche.

- ff. Pygidium with single irregular series of brevaceratubae, consisting of about four oraceratubae on each side; median pair of lobes strongly divergent, free margins serrate; second and third pairs of lobes incised, lobelets subequal in length, distal ends truncate or slightly oblique, slightly serrate; plates long and slender, arranged 0, 1, 1, 4, those of each lateris arranged 1-1-1-1; genacerores 15-15(16-19)16-17; body with prominent tubercle at each cephalo-lateral angle.—*Aulacaspis cinnamomi* Newst.—Java on *Cinnamomum*.-----  
*tubercularis* Newst.
- ee. Pygidium with median pair of lobes entire and with furcapectinae in incisurae; median pair of lobes oblique, distant, broadly rounded, entire; second and third pairs of lobes entire, incised, lobelets similar in form, entire, broadly rounded, mesal lobelet larger than lateral; plates and furcapectinae arranged 0, 1, 1, 4, those of incisurae and one adjacent to each third lobe furcapectinae, cephalic ones much longer than caudal, plates of lateris long, they and furcapectinae arranged 1-1-1-1; genacerores 15-15(26-29)16-17.—*Diaspis* (*Aulacaspis*) *cinnamomi mangiferae* Newst.—Ceylon, Egypt on mango.-----*mangiferae* Newst.
- dd. Pygidium with nine pairs of altaceratubae, sometimes eight, extra ones located on cephalic part; median pair of lobes widely divergent, free margins convex and finely serrate; second and third pairs of lobes incised, lobelets of each pair subequal, those of second larger than those of third, distal margins truncate, margins entire; plates stout, arranged 0, 1, 1, 5-6, those of each lateris arranged 1-1-1-2or3; caudal segment of preabdomen with 4-5 plates on each side; mesogenacerores 15-16, pregenacerores and postgenacerores forming continuous group on each side of 18-22 cerores.—Java.-----  
*javanensis* Newst.
- cc. Pygidium with plates of second and third incisurae not projecting caudad beyond caudal end of median pair of lobes or at most projecting only slightly; median pair of lobes large, long, projecting strongly, distant, distal end broadly rounded, margins minutely serrate; second pair of lobes incised, mesal lobelet twice as long as lateral, elongate, narrow, rounded, both lobelets entire; third pair of lobes incised, mesal lobelet long, narrow, twice as long as broader lateral lobelet, margin of mesal lobelet serrate; plates long, slightly longer than mesal lobelet of second pair of lobes, arranged 0, 1, 1, 5-6, those of each lateris arranged 1-1-1-3or4; genacerores 8-16(14-25)11-26; anus and vulva superimposed; thoracic and cephalic abdominal segments with one and sometimes two pairs of conspicuous depressed dorsal areas.—Ceylon on *Loranthus*.—*loranthi* Green.
- bb. Pygidium with vulva located some distance caudad of anus.
- c. Pygidium with genacerores 8-10(15-18)20-30; median pair of lobes comparatively long, divergent, minutely crenulate, fused

- at proximal end; second pair of lobes elongate, incised, lobelets spatulate, mesal lobelet larger than lateral; plates long, particularly those of lateres, arranged 0, 1, 11, those of each lateris arranged 1-2-2-6; altaceratubae about seven, their oraceratubae located in latadentes, those of second and third incisura elongate, bluntly pointed, none of the oraceratubae adjacent; each lateris with three pairs of adjacent, short, broad, serrate latadentes; rows of oraceratubae of brevaceratubae interrupted on meson and divided into mesal and lateral groups; mesospiracerores forming large cluster.—Ceylon on *Fagraea*.-----*fagraeae* Green.
- cc. Pygidium with genacerores 14-17 (28-37) 26-56; median pair of lobes narrowed at proximal end, expanded at disto-lateral angles and broadly rounded; second pair of lobes incised, lateral lobelet conspicuous, distinctly rounded at distal end, similar in shape to mesal lobelet; brevaceratubae in two rows; mesospiracerores 19-20, metaspiracerores wanting; plates arranged 0, 1, 11, those of each lateris arranged 1-2-5-3; latadentes distinct.—Ceylon on *Myristica*.-----*myristicae* Ruth.
- aa. Body pentagonal in outline, never oval or trigonal, cephalic margin consisting of three subequal portions, mesal transverse portion and on each side an oblique portion which joins straight lateral thoracic margin at an angle; pygidium with median pair of lobes oblique, not or slightly projecting beyond pygidial incision, lateral margins not free, mesal margin slightly convex and serrate; second and third pairs of lobes incised, lobelets bluntly rounded, mesal lobelet slightly longer than lateral; plates of incisurae short, longer than lobes, distinctly shorter than long plates of lateres, arranged 0, 1, 1, 5, those of each lateris arranged 1-1-1-(1-1); latadentes in second and third incisurae nearly as large as lateral lobelets; genacerores in five groups.—Java on *Ilex*.-----*penzigi* Leon.

## SPECIES OF EPIDIASPIS

Pygidium with median pair of lobes large, broad, rounded, faint lateral notch; second, third, and fourth pairs of lobes small, rudimentary, incised, mesal lobelet largest, all probably latadentes; dorsal setae cephalad of second pair of lobes surrounded by densaria-like thickenings; brevaceratubae few in number, elongate, irregularly arranged; plates short, broad, arranged 0, 0, 1, 1, 6, those of each lateris arranged 1-1-1-2-1; anus eight times its width from caudal margin and once caudad of vulva; genacerores (12-16) 9-10.—*Diaspis leperii* Sign., *Epidiaspis piricola* Del Guer.—Italy, France, Portugal, Germany, England, California, New York on apple, plum, peach, pear, currant.-----*pyri* Colvée.

## SPECIES OF COCKERELLASPIS

Pygidium with median pair of lobes distant, rounded, very low, not oblique or divergent, height above margin less than half their breadth; second and third pairs of lobes small, rounded, nearly obsolete; plates small, spine-like, arranged 0, 0, 1, 7, those of each lateris arranged 1-(1-1)-1-3; anus longer than broad, located sixteen times its width

from caudal margin and about five times from vulva; genacerores 5-7 (13-14) 8-8.—New Mexico on *Quercus*.-----*montanus* Ckll.

SPECIES OF DIASPIS

- a. Body of adult female with large, blunt, button-like projection or tubercle on each side on level with rostrum.
- b. Pygidium with an altaceratubae opening in mesal latadentis, with four marginal altaceratubae opening in latadentes on each side and two submarginal altaceratubae; median pair of lobes strongly divergent, oblique, proximal ends not fused, finely serrate; second and third pairs of lobes small, short, incised, lateral lobelet usually larger than mesal; plates comparatively long, spine-like, arranged 0, 1, 1, 7, those of each lateris arranged 1-1-1-3-1, cephalic four much broader at proximal end than others; genacerores 8-12 (6-25) 7-20; mesospiracerores about 18, subdivided into groups.—*Diaspis cattleyae* Ckll.—Europe, Australia, Hawaiian Islands, America on *Acacia*, *Cattleya*, palms, wattle, various hot-house plants. -----*boisdouvallii* Sign.
- bb. Pygidium not with an altaceratuba opening in mesal latadentis, with five marginal altaceratubae opening in latadentes on each side and two submarginal latadentes, two large adjacent brevaceratubae located cephalad of median incisura; median pair of lobes subtriangular, unsymmetrical, divergent, mesal margins serrate; second and third pairs of lobes incised, lobelets subequal with truncated ends with rounded angles, entire, mesal lobelet slightly larger than lateral; cephalad of each third lobe a lobe-like latadentis and cephalad of this a triangular projection, long oblique side, serrate; plates caudad of serrate projection much shorter and narrower on proximal portion than those cephalad, arranged 0, 1, 1, 7, those of each lateris arranged 1-(1-1)-1-(1-1-1); genacerores 0-8 (5-12) 4-8.—South Africa on *Connarus*, *Syzygium*. -----*africana* Lindgr.
- aa. Body of adult female not with large, blunt, projection on each side on level with rostrum.
- b. Pygidium with median pair of lobes distinctly larger than second pair of lobes or at least than second lobelet, if incised.
- c. Pygidium with median pair of lobes entire or at most only slightly crenulate, never with mesal margins serrate.
- d. Pygidium with plates in second and third incisurae.
- e. Pygidium with median and second pairs of lobes wholly entire.
- f. Pygidium with genacerores arranged 9-15 (12-23) 10-24; median pair of lobes with lateral margins free, mesal and lateral margins entire, not strongly oblique; second and third pairs of lobes subequal, incised, mesal lobelet always much larger than lateral, lobelets pointed, rounded, entire; plates short, arranged 0, 1, 1, 8, those on each side of third pair of lobes longest, those on each lateris short and broad at proximal end, all



distant; oraceratubae of lataceratubae located in latadentes; brevaceratubae small and numerous; anus located nearly midway between vulva and caudal margin, nearer vulva; mesospiracerores about 6.—*Diaspis echinocacti* Bouche, *Diaspis echinocacti cacti* Comst., *Diaspis echinocacti opuntiae* Ckll.—Europe, northern Africa, India, eastern United States, New Mexico, Arizona, Mexico, West Indies, Brazil on *Opuntia*, *Echinocactus*, *Cereus*. -----*calyptroides* Costa.

- ff. Pygidium with genacerores arranged 11-11(10-10)3-4; median pair of lobes close together, low, evenly rounded, entire; second and third pairs of lobes represented by extremely small, colorless, pointed prominences; plates large, two on each side especially large and broad with fimbriated ends, pectinae; anus distant from vulva; latadentes bearing oraceratubae at proximal ends of lobes, closely adjacent pair beneath median pair of lobes, and three or four other pairs at intervals along margin.—Mexico on mistletoe.-----*phoradendri* Ckll.
- ce. Pygidium with lateral margin of median pair of lobes and margin of mesal lobelet of second pair serrate; median pair of lobes with mesal margins straight, entire, lateral margins feebly rounded, oblique, only small portion free, finely serrate; second pair of lobes incised, mesal lobelet broader than long, strongly rounded, very finely serrate, lateral lobelet elongate, rounded, rudimentary; third pair of lobes incised, mesal lobelet large, unsymmetrical, straight inner and oblique outer margins, lateral lobelet similar, small, rudimentary; plates of second and third incisurae only slightly longer than lobes, others larger, arranged 0, 1, 1, 6, those of each lateris arranged 1-2-3, distal portion of plates suddenly reduced in size; genacerores 10-20(14-19)8-9.—Syria on *Pistacia*. -----*syriaca* Lindgr.
- dd. Pygidium with furcapectinae in second and third incisurae; median pair of lobes wide apart, large, mesal margins oblique, entire or slightly crenulate, lateral margins only partly free; second pair of lobes incised, short; third pair of lobes incised; latadentis cephalad of each second and third lobe and two caudad of third lobe; plates and pectinae arranged 0, 1, 1, 22, those of each lateris arranged 2-3 and others uniformly distributed cone-like plates, furcapectinae adjacent to each third lobe and about twenty plates cephalad of furcapectinae; caudal segment of preabdomen with twenty-two plates on each side; oraceratubae numerous; mesospiracerores and metaspiracerores 20-25; genacerores 15-28(17-45) 17-32.—Brazil on *Myrtaceae*.-----*australis* Hemp.
- cc. Pygidium with median pair of lobes with mesal margins serrate.
- d. Pygidium with second pair of lobes not incised.

- e. Pygidium with second pair of lobes represented by long bluntly pointed projections; median pair of lobes distant, strongly divergent, mesal margins serrate, caudal end projecting far beyond caudal margin, lateral margin free and entire; third pair of lobes wanting or represented by two low rounded protuberances; pointed projection between median and second lobe probably latadentis; plates shown arranged 0, 0, 1, 1; anus located distinctly caudad of vulva; genacerores 10-10 (20-20) 9-9.—Mexico on Prosopis. -----townsendi Ckll.
- ee. Pygidium with second pair of lobes subround, each rather less than one-half width and length of median lobe, distant by about its own width from median lobe; median pair of lobes largest, almost imperceptibly excavated on distal portion of lateral margin, very slightly notched on distal portion of mesal margin; third pair of lobes about one-half size of second pair, appearing as tubercles on margin, each distant from second lobe rather more than twice its width; with projections identified as fourth and fifth pairs of lobes; plates not large, not long, equaling in length median pair of lobes; anus distant from vulva; genacerores 15-15 (30-30) 20-20.—Mexico on Baccharis.-----baccharidis Towns. & Ckll.
- dd. Pygidium with second pair of lobes always deeply incised.
- e. Pygidium with one plate in each second incisura, each side with eight plates.
- f. Pygidium with one plate in each third incisura.
  - g. Pygidium with five marginal, one mesal, and two submarginal oraceratubae of altaceratubae on each side; median pair of lobes with lateral margins not free, mesal margins serrate, oblique; second and third pairs of lobes subequal, incised, entire, distal ends of lobelets broadly rounded; plates short, arranged 0, 1, 1, 6, those of each lateris distant, arranged 1-(1-1)-1-1-1, cephalic plates much broader than caudal; marginal oraceratubae of altaceratubae located in latadentes, two latadentes on each lateris, located between groups of plates; genacerores 8-10 (14-20) 13-17.—Europe, eastern United States, California, Mexico on Bromella, Hibiscus, Canna, Bilbergia, Olea., pineapple, ivy.-----bromeliac Kern.
  - gg. Pygidium with three or four marginal and submarginal rows of oraceratubae of altaceratubae on each side, two caudal longitudinally elongate and three cephalic small and round; median pair of lobes distant, oblique, mesal margin long and convex, with five distinct serrations including caudal one, lateral margin with single serration; second pair of lobes very small and low, incised; third pair of lobes low, broad, trifid, similar to three mar-

*ginal serrations; plates of second incisurae subequal in length to median pair of lobes, others larger, arranged 0, 1, 1, 6, those of each lateris arranged 1-1-1-(1-1-1); genacerores 8-8(16-16)10-10.—Texas on Sophora. -----texensis* Ckll.

- ff. Pygidium without plates in each third incisurae, plates arranged 0, 1, 0, 4, those of each lateris arranged 1-(1-1)-1, subequal in length to lobes; latadentes located in median, second, and third incisurae, and three on each lateris; median pair of lobes longer than broad, serrate, mesal margin oblique; second and third pairs of lobes incised, lobelets entire, mesal lobelet larger than lateral, distal end of mesal round, of lateral subtruncate; anus located nearly midway between vulva and caudal margin; each lateris with lobe-like projections, caudal one serrate; genacerores (18-23)16-20.—Senegal, Africa on Khaya.-----*senegalensis* Vays.
- ee. Pygidium not with plate in each second incisura, plates short, hardly longer than lobes, arranged 0, 0, 1, 9-13, those of each lateris arranged 1-3or4-6or9; median pair of lobes largest, oblique, serrate; second and third pairs of lobes subequal and subsimilar, incised, mesal lobelet three or more times as large as lateral; five altaceratubae on each side and similar mesal one; lateris irregular and lobe-like opposite cephalic oraceratubae of fourth and fifth altaceratubae; anus about midway between caudal margin and vulva, over six times its width from caudal margin; genacerores 6-10(9-16)6-10.—California on Manzanita, Acrostaphylos. -----*manzanitae* Whitney.
- bb. Pygidium with median pair of lobes distinctly smaller than mesal lobelet of second pair of lobes or of second pair if not incised, if apparently subequal, cephalic end of body with blunt mesal plate-like structure.
  - c. Pygidium with second pair of lobes not incised, as broad as long, broadly rounded, entire, projecting farther caudad than median pair; median pair of lobes small, subtriangular, distal portion notched; third pair of lobes wanting; plates longer than lobes, arranged 0, 1, 8, those of each lateris arranged 2-1-1-4; oraceratubae in three groups, located between groups of plates of each lateris; dorsal setae large; genacerores 8-8 (12-13)8-8.—Canary Islands on Juniperus. ----*atlantica* Lindgr.
  - cc. Pygidium with second pair of lobes deeply incised.
    - d. Body with cephalic margin with single, short, conical, truncate, plate-like, mesal projection; median pair of lobes distant, divergent, lateral margin straight, mesal margin oblique and serrate, subequal to or slightly larger than mesal lobelet of second pair; second pair of lobes incised, entire, truncate with rounded angles, mesal lobelet slightly larger than lateral; third pair of lobes incised, similar in form to second pair, smaller, lateral lobelet sometimes with

lateral notch; plates and pectinae arranged 0, 1, 1, 7, each lateris with caudal and cephalic projections, plates, others furcapectinae, arranged 1-1-1-1-1-1; marginal altaceratubae four, opening in latadentes, located in second and third incisurae and cephalad of caudal plate and between third and fourth from caudal end; margin where fourth pair of lobes would be located, not produced but serrate; genacerores 4-4(10-10)8-8; pygidium of second nymphal female similar to adult.—South Africa on *Strychnos*.-----*stilosa* Lindgr.

- dd. Body with meson of cephalic margin never with mesal plate-like projection; pygidium with median pair of lobes minute, subtriangular, divergent, mesal margin sometimes notched; second pair of lobes incised, mesal lobelet larger than lateral, both broadly rounded, entire; third pair of lobes similar in form and size, incised, entire; plates stout, longer than lobes, arranged 0, 1, 1, 6, those of each lateris broader at proximal end, arranged 1-(1-1)-1-1-1; anus located caudad of vulva; altaceratuba opening in mesal latadentis, four marginal altaceratubae opening in latadentes; mesospiracerores 0-1; genacerores 7-9(13-16)11-14; pygidium of second nymphal female with two pairs of lobes, median pair plate-like, strongly divergent.—German East Africa on *Loranthus*.--  
*parva* Lindgr.

SPECIES OF UMBASPIS

Scale of adult female circular, yellowish or creamy white in color, exuviae tilted; body pyriform; pygidium with median pair of lobes distant, small, projecting, meso-distal angles rounded, entire; second and third pairs of lobes incised, lobelets small, truncately rounded, subequal, entire; one lobe-like projection in each second incisura and three in third; single plate in third incisurae adjacent to third lobe and two cephalad of it; prominent spine-like projection just cephalad of cephalic plates, two plates adjacent to its cephalic margin and three others equidistant from each other and two plates adjacent to spine-like projection; altaceratubae arranged, one in median and each second incisura, two in each third incisura, and two associated with each third pair of lobes, and one with each spine-like projection; mesospiracerores 0-1; genacerores 8-11(16-19)13-16.—Uganda, Africa.-----  
*regularis* Newst.

SPECIES OF RUTHERFORDIA

Pygidium with median pair of lobes fused, forming single lobe, prominent, broader than long, sides parallel on proximal portion, converging on distal portion, rounded at distal end; incisura cephalad of median lobe short, heavily chitinized, two sides fused; plates numerous, long, those of each lateris in three groups, separated by minute, pointed, hyaline, lobe-like projections, arranged 11-12-11, cephalad of these plates, four groups of similar plates, decreasing in size toward cephalic end; genacerores in five groups, very numerous, 100 mesogenacerores; mesospiracerores and metaspiracerores present; brevaceratubae numerous.—Ceylon on *Mallotus*.-----  
*malloti* Ruth.

## SPECIES OF PROTARGIONIA

Scale of adult female oval, exuviae located on one side near periphery; pygidium with median pair of lobes short, projecting only slightly, bluntly pointed, faint notches or few crenulations; second pair of lobes hardly projecting, lateral margin oblique; described third pair of lobes not projecting, bearing seta; altaceratubae large, their oraceratubae one in each second incisura, two in third, and two, more distant, cephalad of rudimentary lobes; plates wanting; spiracerores wanting; genacerores 2-2(9-12)7-11; anus three times its width from caudal margin and distant from vulva.—Argentina on Larrea.-----*larreae* Leon.

## SPECIES OF ESSIGASPIS

Pygidium with lobes, pectinae, and plates wanting; margin broadly undulate; oraceratubae of brevaceratubae very small, numerous, particularly near caudal margin, promiscuously arranged; anus twelve times its width from caudal margin and four times cephalad of vulva; genacerores arranged in almost continuous U-shaped arch, consisting of 20-30 cerores.—California on Quercus.-----*agrifoliae* Essig.

## SPECIES OF SCLOPETASPIS

- a. Pygidium with second pair of lobes not incised; median pair of lobes short, projecting, notched, distant; second pair of lobes similar in form, broader than median pair; third pair of lobes incised, lateral lobelet broader than mesal, lateral margin oblique, dentate, disto-mesal angle prolonged; fourth pair of lobes incised, similar to third pair, broader, distal margin dentate; plates small, inconspicuous, arranged 0, 1, 2, 2, 3; brevaceratubae in broad interrupted bands; oraceratubae numerous on preabdomen; anus longer than broad, about twenty-four times its width from caudal margin, seven times cephalad of vulva, vulva located on the line drawn between pre-genacerores and postgenacerores; genacerores 15-15(30-30)60-60; meso-spiracerores 10, metaspiracerores 4-5; scale covered with white felted woolly wax.—Uganda, Africa on Loranthus.-----*laniger* Newst.
- na. Pygidium with second pair of lobes incised, lobelets subequal in size, prominent, projecting, distal ends rounded, entire; median pair of lobes prominent, distant, similar to mesal lobelet of second pair, larger; third and fourth pairs of lobes incised, similar to each other and to second pair, entire; plates small, arranged 0, 1, 1, 1, 5, those of each lateris arranged 1-4; mesospracerores and metaspiracerores numerous, about twenty; brevaceratubae arranged in three prominent interrupted rows; margin with three large altaceratubae on each side; genacerores arranged in five large groups; anus opposite vulva, vulva located slightly caudad of middle of pygidium; lateral margin of body dilated, forming tubular extension, bearing eye-like spot; cephalic portion of body with numerous chitinated patches.—Java, Uganda, Africa on sugar-cane.-----*madtuncensis* Zehntner.

## SPECIES OF CHIONASPIS

- a. Pygidium with third pair of lobes not incised.
- b. Pygidium with second pair of lobes not incised, broader than long, with or without slight notches, entire; median pair of lobes

broad, broader than long, entire, distant; third pair of lobes triangular, almost obsolete, lateral margin long, oblique, entire; plates longer than lobes, arranged 0, 2, 3, 11, those of each lateris arranged (2-2-2)-4-1; setae small; dorsal oracreratubae arranged in three broad uninterrupted bands; latadentes in second and third incisurae; genacerores 16-19(17-33)13-29.—Algeria on Nerium, Oleander. .... *nerit* Newst.

- bb. Pygidium with second pair of lobes incised, mesal lobelet elongate, broadly bluntly rounded, one-half width of median lobe, lateral lobelet shorter and narrower than mesal; median pair of lobes adjacent at proximal end, divergent caudad, longer than broad, distal end bluntly rounded; third pair of lobes not incised, similar in form to mesal lobelet of second pair; plates about as long as or shorter than median pair of lobes, arranged 0, 2, 2, 8-9, those of each lateris arranged 2-2-4to5; anus located between pregenacerores; each lateris with seven altaceratubae; dorsal oracreratubae small, arranged in rows; genacerores 12-13(20-29)18-22.—China on Populus. .... *micropori* Marl.
- aa. Pygidium with both second and third pairs of lobes incised.
  - b. Pygidium with two plates in each second incisura, only rarely with one, if so, each lateris with plates arranged in two groups.
  - c. Pygidium with genacerores arranged 15-20(30-40)25-30; median pair of lobes triangular, pointed, not adjacent, divergent, entire; second pair of lobes large, smaller than median, incised, mesal lobelet larger than lateral, bluntly rounded; third pair of lobes small, rudimentary; plates twice as long as median pair of lobes, mesal plate of each group shortest, arranged 0, 2, 2, 6, those of each lateris arranged 2-2-2; submarginal setae distinct, marginal setae prominent; anus and vulva superimposed, seven times its width from caudal margin.—Massachusetts, California on Spartina. .... *spartinae* Comst.
  - cc. Pygidium with genacerores always much less in number than 15-20(30-40)25-30.
  - d. Pygidium with median pair of lobes finely serrate, large, longer than broad, bluntly pointed, proximal ends adjacent, divergent caudad; second and third pairs of lobes incised, mesal lobelet largest, distal ends bluntly rounded and toothed; latadentes in second and third incisurae; plates slender, longer than median pair of lobes, not twice as long, arranged 0, 2, 2, 8-9, those of each lateris arranged 2-2or3-4; caudal preabdominal segment with four or five plates on each side; anus located distinctly cephalad of vulva; genacerores 4-6(5-8)2-7.—New York, Virginia, Georgia, Ohio, England, France on Euonymus. .... *euonymi* Comst.
  - dd. Pygidium with median pair of lobes entire, divergent, distance between them nearly equal to width of median lobe, broadly rounded; second pair of lobes incised, lobelets large, mesal larger than lateral, slightly longer than broad, entire, broadly rounded; third pair of lobes incised, lobelets subequal in width, mesal larger than lateral, distinctly long-

er than broad, entire, lateral margin oblique; plates much longer than lobes, arranged 0, 1-2, 1-2, 4-5, those of each lateris in two groups, arranged 1 to 2, 3; dorsal oraceratubae numerous, arranged in rows; genacerores 7-12(18-24)15-17.—South Africa on *Stanotophrum*.-----*stanotophri* Cooley.

- bb. Pygidium always with less than two plates in each second incisura; each lateris with plates arranged in two groups.
- c. Pygidium with one plate in each second incisura.
- d. Pygidium with median pair of lobes not adjacent at proximal end.
  - e. Pygidium with median pair of lobes as broad as long, broadly truncately rounded, entire, separated by distance equal to about one-fourth width of median lobe; second and third pairs of lobes incised, mesal lobelets largest, lobelets about as broad as long, broadly rounded, entire; latadentes in second and third incisurae; plates one-fourth longer than lobes, arranged 0, 1, 1, 4-7, those of each lateris arranged 1-1-lor2-lor3; dorsal oraceratubae not numerous; anus located slightly cephalad of vulva; genacerores 7-13(12-21)14-19.—United States, Canada on *Pinus*, *Pseudotsuga*, *Abies*, *Torreya*.-----*pinifoliae* Fitch.
- ee. Pygidium with median pair of lobes distinctly longer than broad.
  - f. Pygidium with median pair of lobes subquadrangular, mesal and lateral margins subparallel, distal ends bluntly pointed at middle with mesal portion minutely serrate and lateral portion notched; second and third pairs of lobes incised, mesal lobelet slightly larger than lateral, entire, bluntly pointed; plates long, arranged 0, 1, 1, 7, those of each lateris arranged 1-1-5; lateres notched, each with four latadentes bearing oraceratubae; dorsal oraceratubae arranged in rows; anus its own width cephalad of vulva; genacerores 12-19(35-40)27-35.—Ceylon on *Polygonum*.-----*polygoni* Cooley.
  - ff. Pygidium with median pair of lobes triangular or conical, mesal and lateral margins convergent caudad and pointed.
    - g. Pygidium with seven altaceratubae on each side; lobes crowded onto subtruncate caudal portion; median pair of lobes pointed, distant, not oblique; second and third pairs of lobes incised, lobelets subequal, pointed, nearly as large as median pair of lobes; plates stout, arranged 0, 1, 1, 6-7, those of each lateris arranged 1-1-4or5, plates between lobes much shorter and smaller than others; genacerores 15-25(18-37)14-22; mesospiracerores crowded groups; anus superimposed over vulva or slightly caudad.—Ceylon on *Vitis*, *Elaeagnus*, *Loranthus*.-----*vitis* Green.

- gg. Pygidium with eight altaceratubae on each side; lobes normal in position, not crowded onto subtruncate caudal portion; median pair of lobes slightly divergent, bluntly pointed or rounded, long; second and third pairs of lobes incised, second pair slightly larger than third, lobelets all similar in form, distal end bluntly rounded, mesal lobelet larger than lateral; plates long, much longer than lobes, arranged 0, 1, 1, 5-6, those of each lateris arranged 1-1-3or4; genacerores 14-16(22-28)15-20; mesospiracerores and metaspiracerores present; anus superimposed over vulva or slightly cephalad.—Ceylon on Hedyotis. ----- *hedyotidis* Green.
- dd. Pygidium with median pair of lobes adjacent at least at proximal end.
- e. Pygidium with median pair of lobes as long as or longer than broad.
- f. Pygidium with four to nine plates on each lateris, rarely with only three.
- g. Pygidium with mesal margins of median pair of lobes straight, parallel, adjacent, distal margins rounded, sides obscurely serrate; second and third pairs of lobes incised, mesal lobelet of each lobe three times size of lateral lobelet, entire or obscurely serrate; plates not long, arranged 0, 1, 1-2, 7-9, those of each lateris arranged 2-2-4-5; anus located distinctly cephalad of vulva; dorsal oraceratubae arranged in transverse rows; genacerores 10-25(13-35) 16-24.—Massachusetts, Ohio, Missouri, Kansas, Nebraska, New Mexico, southern California on willow, cottonwood, poplar, honey-locust, butternut.-----  
*ortholobis* Comst.
- gg. Pygidium with mesal margins of median pair of lobes distinctly divergent distad.
- h. Pygidium with genacerores arranged 37-37(41-43) 43-43; median pair of lobes large, adjacent at proximal end, strongly divergent caudad, mesal and lateral margins of each lobe convergent, meeting in right angle, entire or slightly notched; second and third pairs of lobes incised, mesal lobelets of third pair larger than lateral; plates of second incisura shorter than lobes, others longer, arranged 0, 1, 2-3, 11-12, those of each lateris arranged 3-4-4or5; each lateris with three small pyramidal projections between two caudal groups of plates; dorsal oraceratubae conspicuous, arranged in rows.—Japan on *Elaeagnus*.-----  
*difficilis* Ckil.
- hh. Pygidium with genacerores never more than 19(44)30.



- i. *Pygidium* with *brevaceratubae* of first and second rows wanting, those of third and fourth rows numerous; median pair of lobes elongate, tapering, bluntly pointed, serrate; second pair of lobes incised, mesal lobelet elongate, more than twice as long as lateral, lateral margin oblique, serrate, lateral lobelet bluntly rounded; third pair of lobes rudimentary, incised, lobelets broader than long, lateral margins oblique, serrate; plates stout, arranged 0, 1, 1, 5-6, those of each lateris arranged 1-1-3or4; anus located slightly cephalad of vulva; genacerores 4-10(12-21)8-14.—Ohio on *Gleditsia*.....  
*gleditsiae* Saunders.
- ii. *Pygidium* with *brevaceratubae* of first or second rows or both rows present.
  - j. *Pygidium* with median pair of lobes with distal portion bluntly pointed or obscurely trilobed, faintly serrate; second and third pairs of lobes incised, mesal lobelet much larger than lateral, bluntly rounded, faintly serrate; plates long, slender, arranged 0, 1, 1-2, 9-14, those of each lateris arranged 2-1 or 3-6or9, usually with one plate in each third incisure and two on lateris adjacent each third lobe; *brevaceratubae* 3-6 in mesal group of second row, 4-6 in mesal group and 5-7 in lateral group of third row, 6-8 in mesal group and 8-10 in lateral group of fourth row; anus located cephalad of vulva; genacerores 11-19(25-42)19-28. — Canada, Massachusetts, New York on *Alnus*, *Salix*, *Viburnum*, *Cornus*, *Benzoin*, *Amelanchier*, *Betula*, *Dirca*, etc.....  
*linthneri* Comst.
  - jj. *Pygidium* with median pair of lobes with distal portion broadly bluntly rounded.
  - k. *Pygidium* with *brevaceratubae* with mesal group of second row 7, third row in two groups, 9 lateral and 7 mesal, fourth row in three groups, 13 lateral, 4 median and 3 mesal, fifth row in two groups, 11 lateral and 5 mesal; median pair of lobes prominent, sides subparallel, distal ends bluntly rounded; second pair of lobes incised, mesal lobelet longer and broader than lateral, less than one-half width of median lobe; third pair of lobes incised, mesal lobelet distinct, lateral lobelet small, obscure; plates slightly longer than median pair of lobes, arranged 0, 1, 2, 9-10, those

of each lateris arranged 2-2-5or6; anus located near middle of length of pregenacerores; genacerores 13-13(24-25)16-22.—California on orange....*sassceri* Ckll. & Robs.

- kk. Pygidium with brevaceratubae with first row wanting, second row with one group, mesal 2-6, third row with two groups, lateral 5-9 and mesal 4-9, fourth row in two groups, lateral 3-9 and mesal 3-8; median pair of lobes as broad as long, serrate, distal end bluntly rounded; second and third pairs of lobes incised, mesal lobelet much larger than lateral, serrate; plates long, slender, arranged 0, 1, 1-2, 5-11, those of each lateris arranged 1or2-1or2-3or7, usually with two plates in each third incisura and with two on each lateris adjacent to third lobe; anus located about its own width cephalad of vulva; genacerores 11-23 (21-44) 18-33.—Europe on *Salix*, *Populus*, *Alnus*, *Cornus*, *Acer*, *Vaccinium*, *Tilia*, *Sorbus*, *Fraxinus*, *Sarcolthamnus*.....  
*saltis* Linn.

- ff. Pygidium with two to three plates on cephalic part of each lateris.

- g. Pygidium with median pair of lobes with mesal margins divergent from proximal end, lobes large, broadly bluntly rounded, serrate; second pair of lobes incised, lobelets broadly bluntly rounded, mesal lobelet more than twice as long as lateral, margins serrate; third pair of lobes incised, mesal lobelet much longer than lateral, oblique, lateral lobelet inconspicuous, margins serrate; plates long and stout, arranged 0, 1, 2, 4-7, those of each lateris arranged 1or2-1or2-2or3, cephalic plates longer than caudal; dorsal oraceratubae arranged in rows; genacerores 10-16(20-24)10-17.—Texas on cottonwood.  
*longiloba* Cooley.

- gg. Pygidium with median pair of lobes with mesal margins contiguous on proximal half and divergent on distal half, large, prominent, distal and lateral margins broadly rounded, crenulate; second and third pairs of lobes incised, lobelets wedge-shaped, broad end directed distad, mesal lobelets larger than lateral, margins crenulate; plates of incisurae only slightly longer than lobes, arranged 0, 1, 1, 4-5, those of each lateris arranged 1-1-2or3; anus its own width caudad of vulva; dorsal oraceratubae arranged in rows; altaceratubae six on each side; genacerores 8-18(15-20)8-18.—Ceylon on *Elaeagnus*. ....*elaegni* Green.

- ee. Pygidium with median pair of lobes distinctly broader than long.
- f. Pygidium with genacerores arranged 18-36(31-47) 28-39.
- g. Pygidium with median pair of lobes strongly oblique, adjacent only for short distance at proximal end, divergent, entire, bluntly pointed at caudal end; second pair of lobes incised, mesal lobelet largest, each bluntly pointed; third pair of lobes smaller than second, incised, mesal lobelet largest; plates about twice as long as lobes, arranged 0, 1-2, 1-2, 5-6, those of each lateris arranged 1-1-(1-1-1-1); dorsal oracera-tubae conspicuous, arranged in rows; altaceratubae opening in latadentes, 7 on each side; anus about its width cephalad of vulva; spiracerores conspicuous; genacerores 18-21(33-47)31-39.—Ceylon on *Panicum*, *Ischaemum*, *Ophismenus*, other grasses. *herbae* Green.
- gg. Pygidium with median pair of lobes not strongly oblique, mesal margins adjacent for proximal half of length, broad, short, broadly rounded, entire or faintly serrate; second pair of lobes large, incised, mesal lobelet twice as large as lateral, margins broadly rounded, entire or faintly serrate; third pair of lobes distinct, incised, mesal lobelet larger than lateral, both broader than long, margins broadly rounded, entire or faintly serrate; plates long and slender, arranged 0, 1, 1-2, 7-11, those of each lateris arranged 1or2-1or3-5or6; dorsal oracera-tubae conspicuous, arranged in rows; genacerores 21-36(31-45)28-32.—United States, Canada on willow, poplar, *Cornus*, *Amelanchier*, *Ceanothus*, *Liriodendron*.-----  
*salicis-nigrac* Walsh.
- ff. Pygidium with genacerores arranged 7-16(11-32)7-22.
- g. Pygidium with genacerores arranged 2-7(7-11)6-13, usually about 4-4(10-10)6-8; median pair of lobes spatuliform, adjacent, scarcely divergent, entire; second pair of lobes incised, mesal lobelet like median, lateral smaller; third pair of lobes incised, mesal lobelet broad, notched, oblique, margin rounded, rudimentary, lateral lobelet similar, small; plates of second incisurae one-half length of median pair of lobes, others longer, arranged 0, 1, 1, 5, those of each lateris arranged 1-1-3, one and one-half times length of caudal plates; lateres with prominent latadentes.—Austria on *Pinus*.-----*austrica* Lindgr.
- gg. Pygidium with at least some of groups of genacerores more numerous than 7(10)8.
- h. Pygidium with second row of brevaceratubae wanting, lateral group sometimes represented by about two pores, third and fourth rows represented; median pair of lobes well developed, en-

tire, broadly rounded, mesal margins straight and adjacent; second pair of lobes entire, incised, mesal lobelet much larger than lateral, lateral margin oblique, lateral lobelet triangular; third pair of lobes entire, incised, lobelets similar in shape, smaller than second pair; plates long, slender, arranged 0, 1, 1, 5-6, those of each lateris arranged 1-1-3or4; genacerores 7-9(11-16)7-20.—New Zealand on *Dysoxylon*, *Hoheria*, *Melicytus*...

*dysoxyli* Mask.

- hh. Pygidium with second row of brevaceratubae present, lateral group with 2-5, mesal group sometimes wanting.

i. Pygidium with median pair of lobes with proximal portion of mesal margins straight, adjacent, distal portion longer than proximal, straight and strongly oblique, lateral margin rounded, margins entire or finely serrate; second pair of lobes incised, mesal lobelet much larger than lateral, more than twice as long, both broadly rounded, entire; third pair of lobes incised, similar but smaller than second pair; plates long, slender, arranged 0, 1, 1, 6-10, those of each lateris arranged 1or2-1or 2-4or6; dorsal oraceratubae arranged in rows; anus located about its own width cephalad of vulva; genacerores 9-15(17-28)9-17.—Massachusetts, New York, Ohio on *Cornus*...*corni* Cooley.

ii. Pygidium with median pair of lobes broadly rounded, proximal portion of mesal margin near but not adjacent and caudal portion strongly divergent and forming with distal and lateral margins broad curve; second pair of lobes incised, mesal lobelet three times as long as lateral, both broadly rounded, margins entire or finely serrate; third pair of lobes incised, short, lobelets much broader than long, distal margins truncate or roundly truncate, serrate; plates long, slender, arranged 0, 1, 1, 6-11, those of each lateris arranged 1-1-4or9, plate in each second incisura small, shorter than median lobe; dorsal oraceratubae arranged in rows; anus located its own width cephalad of vulva; genacerores 7-16(22-32)16-22.—United States, Canada, England on apple, pear, cherry, quince, peach, choke-cherry, walnut, mountain ash, elm, *Pyrus*, currant, hawthorn.....

*furfuræ*, Fitch.

- cc. Pygidium without plates in each second incisura, plates arranged 0, 0, 2, 7, those of each lateris arranged 2-(1-2)-(1-1),

plates only slightly longer than median pair of lobes; median pair of lobes not adjacent, quadrangular, entire; second pair of lobes incised, lobelets small, lateral lobelet twice or more as large as mesal; third pair of lobes incised, lobelets subequal, smaller than lateral lobelets of second pair; anus located slightly caudad of vulva; mesospiracerores 3, metaspiracerores 2; genacerores 15-17(23-30)10-16.—Italy on *Tamarix*.-----  
*etrusca* Leon.

## SPECIES OF DUPLACHIONASPIS

- a. Pygidium with second pair of lobes not incised.
- b. Pygidium with median pair of lobes distinctly divergent.
  - c. Pygidium with each median pair of lobes twice as broad as second lobe, caudal portion expanded, malleiform, appearing notched on middle of mesal margin, entire; second pair of lobes simple, prominent, narrow, bluntly pointed, entire; plates well developed, plates arranged so far as shown, none in median incisura, one in second, one cephalad of each second lobe, another about as far cephalad as distance between two caudal plates; anus located cephalad of vulva; dorsal oracratubae arranged in conspicuous rows; genacerores 6-8(11-17)17-20.—Australia on *Callistemon*.-----*candida* Green.
  - cc. Pygidium with each median lobe distinctly narrower than second lobe; median pair of lobes strongly divergent, twice as long as wide, mesal and lateral margins subparallel, distal end bluntly rounded, entire, proximal ends distant; second pair of lobes large, truncately rounded, as long as median pair; plates longer than lobes, arranged 0, 2, 5-6, those of each lateris arranged 3-1or2-1, described plates of each second incisura probably a latadentis; genacerores 7-8(14-19)11-14.—*Chionaspis berlesii* Leon. (Lindgr.)—Canary Islands on *Plocama*, *Micromeria*, *Ruta*, *Salsola*, *Cneorum*, *Cytisus*.-----*canariensis* Lindgr.
- bb. Pygidium with median pair of lobes quadrangular, not divergent.
  - c. Pygidium with median and second pair of lobes distinct.
    - d. Pygidium with median pair of lobes crenulate at distal end.
      - e. Pygidium with genacerores arranged 6-10(8-12)10-14; median pair of lobes subquadrate, short, conspicuous because of their dark color, distal end crenulate; second pair of lobes indicated as short rounded structures, triangular; plates long and spine-like, arranged 0, 1, 2, those of each lateris distant; anus distant from caudal margin; submarginal region with transverse elongate groups of oracratubae; second nymphal female with median pair of lobes large, quadrate, distant; lateres strongly serrate; plates long and spine-like.—Natal on *Capparis*.-----  
*retigera* Ckll.
    - ee. Pygidium with genacerores arranged 1-7(8-13)23-30; median pair of lobes quadrangular, mesal and lateral margins straight, caudal end irregularly and coarsely ser-

rate; second pair of lobes rudimentary, sometimes obsolete, broader than long, broadly rounded, entire; plates long, slender, longer than median lobes, arranged 0, 1, 3, those of each lateris arranged 1-(1-1); dorsal oracratubae in large, well marked groups or bands; anus between pregenacerores; mesospiracerores 4-5; lateres with irregular projections.—Southwest Africa on *Rhus*.-----

*mytilaspiformis* Newst.

- dd. Pygidium with median pair of lobes quadrangular, distal margin with mesal and lateral notches, rounded between notches; second pair of lobes longer than broad, bluntly rounded, one-half width of median lobe; altaceratubae in nine pairs, arranged 1-2-2-2-2, their oracratubae very large; plates arranged 0, 1, 7, those of each lateris arranged 1-2-2-2, placed between altaceratubae; brevaceratubae numerous, prominent; genacerores 2-4(12-16)15-23; anus located about eleven times its width from caudal margin.—Australia on *Eucalyptus*. -----*frenchi* Green.
- cc. Pygidium with median and second pair of lobes small and inconspicuous, delicate; median pair of lobes with sides subparallel, distal end rounded, entire; second pair of lobes similar in form to median; plates longer than lobes, sharply pointed, proximal portion broad, arranged 0, 1, 2, one on each lateris adjacent second lobe, other short distance cephalad; lateres irregular, dentate; brevaceratubae apparently few; genacerores 8-14(13-18)6-14.—South Africa on aloe.-----*exalbida* Ckll.
- aa. Pygidium with second pair of lobes incised.
  - b. Pygidium with median pair of lobes with proximal portion of their mesal margins contiguous, sometimes apparently fused.
    - c. Pygidium with median pair of lobes smaller than mesal lobelet of second pair, broad, not prominent; second pair of lobes entire, incised, mesal lobelet large, broadly rounded, broader than long, projecting, three times as large as lateral lobelet; plates on caudal portion about one-half size of those on cephalic portion, arranged 0, 2, 9, those of each lateris arranged 2-2-(1-1)-1-2; tooth-like latadentis near middle of each lateris; anus distant from caudal margin; genacerores 10-10(14-14)10-15.—Algeria on *Deverra*.-----*bilobis* Newst.
    - cc. Pygidium with median pair of lobes distinctly larger than mesal lobelet of second pair, subtriangular in outline, bluntly pointed, crenulate, fused at proximal ends, mesal margins divergent, lateral margins oblique; second pair of lobes incised, mesal lobelet much larger than lateral, lobelets triangular, entire; plates or furcapectinae, arranged 0, 0, 1; genacerores 5-7(8-14)19-25.—Transvaal, Africa on *Acacia*.-----*capra* Brain.
  - bb. Pygidium with median pair of lobes not with proximal portion of mesal margins fused for short distance.
    - c. Pygidium with two plates in each second incisura.

- d. Pygidium with plates short and slender, arranged 0, 2, 7, those of each lateris arranged 2-2-1-2; median pair of lobes entire, long, narrow, bluntly pointed, spatulate; second pair of lobes incised, mesal lobelet much larger than lateral, slightly smaller than median lobe, similar in shape; genacerores 13-13(18-24)14-17; mesospiracerores and metaspiracerores present; anus and vulva superimposed.—Ceylon on *Andropogon*. ----- *divergens* Green.
- dd. Pygidium with plates slender, arranged 0, 2, 10, those of each lateris arranged 2-2-1-5or6; median pair of lobes elongate, subparallel, distal ends rounded or bluntly pointed, entire; second pair of lobes incised, entire, mesal lobelet much larger than lateral, nearly as wide as median lobe, rounded; genacerores 14-16(30-43)20-27; mesospiracerores and metaspiracerores present; anus superimposed over vulva.—Ceylon on *Andropogon*. ----- *graminis* Green.
- cc. Pygidium with one plate in each second incisura.
- d. Pygidium with distance between median pair of lobes never more than width of median lobe.
- e. Pygidium with fifteen to sixteen plates on each lateris, plates arranged 0, 1, 15-16, those of each second incisura small, those of each lateris arranged 3-2or3-10; median pair of lobes large, rounded, broader than long, distinct lateral notch, narrowly separated; second pair of lobes incised, lobelets subequal, triangular, together much smaller than median lobes; thorax, preabdomen, and pygidium with numerous brevaceratubae; mesospiracerores represented by large compact groups; genacerores 2-8(23-35)42-65; anus located near mesogenacerores, caudad of vulva.—British East Africa on wild fig tree.----- *fici* Newst.
- ee. Pygidium with ten or eleven plates on each lateris.
- f. Pygidium with two or three plates on each lateris.
- g. Pygidium with postgenacerores 36-46; median pair of lobes as broad as long, broadly rounded, entire; second pair of lobes incised, mesal lobelets nearly as long as median lobe, longer than broad, bluntly pointed, entire, lateral lobelet similar in form but smaller; plates long, much longer than lobes, arranged 0, 1, 3, those of each lateris arranged 1-2; lateres irregular; genacerores 4-9(16-23)36-46.—South Africa on *Chaetachme*.----- *chaetachmae* Brain.
- gg. Pygidium with postgenacerores 8-22.
- h. Pygidium with three plates on each lateris, arranged 1-1-1, plates long, stout, two or three times as long as lobes; median pair of lobes subtriangular, pointed, lateral and mesal margins convex at middle, serrate; second pair of lobes incised, mesal lobelet subquadrangular, distinct mesal and lateral notches, nearly as large as median lobe,

lateral lobelet small, much smaller than mesal, bluntly pointed, lateral notch; lateres irregular; genacerores 3-4(4-9)8-13.—South Africa on *Caparis*. -----*capparis* Brain.

hh. Pygidium with two plates on each lateris.

i. Pygidium with mesal lobelet of second pair of lobes distinct, never inconspicuous; median pair of lobes triangular, pointed, one or two mesal notches, lateral margin oblique; second pair of lobes incised, mesal lobelet entire, distal end bluntly rounded, nearly twice as large as lateral; plates small, slender, longer than lobes, arranged 0, 1, 2, those of each lateris distant; lateres irregular; genacerores 2-4(14-20)19-22.—South Africa on *Euphorbia*.---*euphorbiae* Brain.

ii. Pygidium with mesal lobelet of second pair of lobes inconspicuous, narrowed toward proximal end, spatulate, lateral lobelet smaller than mesal, tapering; median pair of lobes conspicuous, short, wide, divergent, truncate; plates arranged 0, 1, 2, those of each lateris arranged one near second lobe and the other short distance cephalad; genacerores 4-8(13-15)19-21.—West Australia on *Agonis*.-----*agonis* Fuller.

ff. Pygidium with four or more plates on each lateris.

g. Pygidium with second pair of lobes small and inconspicuous, mesal lobelet never subequal in size to a median lobe.

h. Pygidium with median pair of lobes large and conspicuous.

i. Pygidium with second pair of lobes incised, lobelets subequal, similar, triangular, or slightly truncate; median pair of lobes conspicuous, apparently diverging, wide and short, distant, entire; latadentes present cephalad of second pair of lobes, three groups of two each on each lateris; mesal margin of median pair of lobes and median incisura thickened, horse-shoe-shaped; plates long, slender, much longer than lobes, arranged 0, 1, 3, those of each lateris arranged 1-1-1 and placed adjacent to and cephalad of each group of latadentes, genacerores 5-5(11-15)15-21.—West Australia on *Eucalyptus*.-----*ethelae* Fuller.

ii. Pygidium with second pair of lobes incised, mesal lobelet three or four times size of lateral, subtriangular, distal end bluntly rounded; median pair of lobes large, projecting, mesal margins oblique, undulate; plates large, dagger-



shaped, arranged 0, 1, 6; genacerores in five almost contiguous groups, arranged 4-7(11-18)

26-32.—South Africa on *Leucadendron*.....  
*leucadendri* Brain.

hh. Pygidium with median pair of lobes short, conical, separated by slight wedge-shaped depression; second pair of lobes incised, mesal lobelet longer and larger than lateral, lateral short, wide, rounded at caudal end; each lateris with its margin prolonged and thickened in three places, probably altaceratubae, plates tapering, very long, situated caudad of lobes and prolongations of margin, arranged 0, 1, 4, those of each lateris arranged 1-1-1-1; genacerores 4-4(19-20)25-30.—South Australia on *Xanthorrhoea*.....*xanthorrhoeae* Fuller.

gg. Pygidium with second pair of lobes incised, mesal lobelet larger than lateral, often approximating a median lobe in size; median pair of lobes well developed, distant, separated by distance about equal to width of median lobe; plates prominent, arranged 0, 1, 4-5, those of each lateris arranged 1-1or2-2; latadentes located in median and second incisurae and associated with plates of lateres; lateres cleft at intervals, margin denticulate; genacerores 5-7(9-14) 7-14.—District of Columbia on East Indian bamboo...  
*howardi* Cooley.

dd. Pygidium with distance between median pair of lobes more than twice width of a median lobe.

e. Pygidium with median pair of lobes subquadrangular, mesal and lateral margins parallel, caudal margin transverse, with three teeth; second pair of lobes distinct, incised, lobelets long, slender, caudal ends rounded, mesal larger than lateral; plates only slightly longer than lobes, arranged 0, 1, 2, those of lateris placed one near second lobe and other distant and very small, other plates may be present; dorsal oraceratubae numerous on all parts of body, arranged in regular series on pygidium; genacerores 10-10(26-32)30-42.—Niger, Africa on *Xymenia*.....  
*nigerensis* Vayss.

ee. Pygidium with median pair of lobes triangular, pointed, lateral and mesal margins oblique and concave, shouldered on proximal portion, about as broad as long; second pair of lobes incised, mesal lobelet similar in form to median, as large or larger than median, lateral lobelet triangular, small, one-third size of mesal lobelet; plates twice as long as lobes, proximal portion stout, arranged 0, 1, 2, those of each lateris distant; lateres irregular; genacerores 7-8 (18-23)34-40.—South Africa on aloe.....*margaritae* Brain.

SPECIES OF UNACHIONASPIS

- a. Pygidium with median pair of lobes large and distinct.
- b. Pygidium always with less than ten plates on each lateris.
  - c. Pygidium with genacerores 2-3(2-3)2-3; median pair of lobes large, projecting, constricted at proximal end, separate; plates arranged 0, 5, those of each lateris arranged 1-1-1-1-1; anus located near middle of length of pygidium; scale of adult female pyriform.—South Australia on Eucalyptus.-----  
*assimilis* Mask.
  - cc. Pygidium with genacerores 7-11(10-14)6-9; median pair of lobes large, proximal half of mesal margins parallel, subadjacent, distal portion diverging, distant, lateral margins oblique, long, crenulate; plates, except one adjacent median lobe, long and dagger-like, arranged 0, 5, those of each lateris arranged 1-2-2; lateres with latadentes; setae slender, about as long as median lobes; spiracerores wanting.—South Africa on lilac.---  
*ambigua* Brain.
  - bb. Pygidium with eleven to fourteen plates on each lateris, arranged 3-3-5-8, wanting in median incisura; median pair of lobes large, elongate, crenate on both margins, adjacent at proximal end, divergent caudad; each lateris with two shallow notches, one between each two groups of plates; segments of preabdomen and thorax, beginning at caudal end, bear plates on each side, as follows: 9-5-8-4 or more—4 or more, only rudiments; genacerores in five groups.—Antigua on Heliotrope.-----*major* Kkll.
- aa. Pygidium with median pair of lobes small and inconspicuous.
  - b. Pygidium with six or more large plates; median pair of lobes pointed, triangular, almost invisible, other lobes represented by angular projections, distant, twice width of one of them apart; plates several times length of lobes, large, prominent, arranged 0, 7, those of each lateris arranged 1-1-2-(1-1-1), cephalic plate forked; dorsal oraceratubae numerous near caudal margin; anus located between pregenacerores; genacerores 7-10(12-16)9-15.—Japan on bamboo.-----*colemani* Knw.
  - bb. Pygidium with two short, stout plates on each lateris, distant from each other and from cephalic plate, smaller than caudal; median pair of lobes small, identified as plates by Brain, short, notched at distal end, broad as long; lateres irregular, with indentations; mesospiracerores 4-5; genacerores 3-5(4-6)4-7.—South Africa on Euphorbia.-----*globosus* Brain.

SPECIES OF FUNDASPIDIS

- a. Pygidium with distinct mesal indentation, marking division between two median lobes.
- b. Pygidium with median pair of lobes with distinct lateral notch, otherwise entire, distal end bluntly rounded, each lobe longer than broad; second pair of lobes incised, mesal lobelet with its lateral margin oblique with two notches, more than twice as long as lateral lobelet, lateral lobelet small and inconspicuous, entire or

- with single notch; third pair of lobes incised, small, inconspicuous; plates and pectinae long, slender, those of each side of each third lobe often furcapectinae, arranged 0, 1, 1-2, 9-13, those of each lateris arranged 2-2to4-5to7; dorsal oraceratubae few in number, arranged in rows; anus located about its own width cephalad of vulva; genacerores 20-30(18-42)20-30.—Massachusetts, Connecticut, New York, Ohio, Illinois, Minnesota, Missouri, Kansas, Oklahoma, Texas on *Ulmus*.-----*americana* Johns.
- bb. Pygidium with median pair of lobes not with distinct lateral notch.
- c. Pygidium with median pair of lobes entire, not notched, large, each broader than long, broadly rounded; second pair of lobes incised, mesal lobelet oblique, much longer than broad and larger than lateral lobelet, their lateral margins serrate; third pair of lobes not well marked, incised, mesal lobelet larger than lateral, both oblique and longer than broad, lateral margins serrate; plates arranged 0, 1, 1, 7-10, those of each lateris arranged 1-1to2-5to7; dorsal oraceratubae present, arranged in rows; genacerores 12-19(21-29)15-22.—District of Columbia on hickory. -----*caryae* Cooley.
- cc. Pygidium with median pair of lobes serrate, fused on proximal two-thirds, diverging at distal ends, forming deep notch, lateral margins oblique; second pair of lobes deeply notched, mesal lobelet triangular, larger than lateral, lateral margin oblique, serrate, lateral lobelet triangular, entire; third pair of lobes broader than long, oblique, serrate; plates not long, those of second incisurae not as long as median lobe, arranged 0, 1, 1, 1, 5-8, those of each lateris arranged 1-1to2-4to6; dorsal oraceratubae arranged in rows; anus located slightly cephalad of vulva; genacerores 7-10(15-26)14-18.—Ohio on *Nyssa*. -----*sylvatica* Sand.
- aa. Pygidium with median pair of lobes completely fused, mesal indentation wanting, entire, lobes broader than long, truncate with rounded angles; second and third pairs of lobes not incised, each caudad of reniform thickening, not prominent, entire, bluntly pointed; plates subequal in length to median pair of lobes, arranged 0, 1, 1, 13-14, those of each lateris arranged 2to3-5-6; anus located thirteen times its width from caudal margin and twice its width cephalad of vulva; genacerores 10-10(17-20)10-18.—California, New Mexico, Mauritius on *Quercus*, Pasania.-----*quercus* Comst.

## SPECIES OF AFRICASPIS

- a. Pygidium without plates adjacent to each median lobe; median pair of lobes fused, three deep indentations forming four subequal rounded lobules, mesal indentation marking division between lobes; other lobes wanting; plates about as long as median pair of lobes, arranged 0, 3-4, those of each lateris arranged 0-1-2to3-0-0; three adjacent tooth-like projections between each median lobe and caudal plate, single projection between caudal plate and next group; dorsal oraceratubae numerous, especially on thorax; anus located near

middle of groups of genacerores; mesospiracerores 3-4; altaceratubae present; genacerores 6-8 (23-23) 28-36.—Uganda, Africa.-----

*chionaspiformis* Newst.

- aa. Pygidium with two plates adjacent to median pair of lobes; median pair of lobes fused for half their length, deep lateral notch and mesal indentation, forming two prominent rounded lobules; other lobes wanting; plates longer than lobes, arranged 0, 7-8, those of each lateris arranged 2-1-2-1-to2; each lateris with minute tooth-like projections between groups of plates; group of 5-7 setae near spiracles; dorsal oraceratubae in rows; altaceratubae few in number; genacerores 6-11 (17-26) 20-32.—Uganda, Africa on Cassia.-----

*cassiae* Newst.

SPECIES OF GREENASPIS

Body of adult female elongate, six or more times as long as wide, head and thorax constituting over one-fourth of length of body, sides of caudal segments of preabdomen strongly produced and bearing two or three plates; pygidium with median pair of lobes prominent, divergent, mesal margins emarginate; second pair of lobes incised, mesal lobelet truncate, much larger than lateral; plates stout, 0, 1, 5-6, those of each lateris arranged 1-1-1-2to3; genacerores 4-6 (8-10) 10-10; mesospiracerores 1-2; anus located slightly cephalad of vulva.—Ceylon on Arundinaria. -----*elongata* Green.

SPECIES OF TENUIASPIS

Body of adult female small, averaging less than one millimeter; segments of preabdomen without plates; pygidium with median pair of lobes projecting, minute, narrow, bluntly rounded; second pair of lobes incised, minute, inconspicuous; plates comparatively large, twice as long as the lobes, arranged 0, 1, 7-8, those of each lateris arranged 1-1-1-4to5; altaceratubae four on each side; brevaceratubae located only near altaceratubae; genacerores 4-6 (9-12) 8-8; mesospiracerores represented by small group of pores; anus located twice its width cephalad of vulva.—Ceylon on Tetranthera.-----*minuta* Green.

SPECIES OF UNASPIS

Body of adult female long and narrow, about three times as long as wide, caudal portion widest; pygidium with median pair of lobes projecting, wedge-shaped, lateral margins free, distal ends truncately rounded, entire; second and third pairs of lobes incised, lobelets wedge-shaped, mesal lobelet larger than lateral, margins entire; plates short and stout, arranged 0, 0, 0, 4, those of each lateris arranged 1-1-2; altaceratubae six on each side; brevaceratubae numerous, promiscuously arranged; genacerores 4-4 (6-7) 4-5; mesospiracerores represented by small group; anus and vulva superimposed.—Ceylon.-----*acuminata* Green.

SPECIES OF LINEASPIS

Pygidium with median pair of lobes plate-like or spine-like, short, distance between them four times their length; second pair of lobes normal in form, broader than long, broadly rounded; other lobes wanting;

plates short, spine-like, subequal in length to median pair of lobes, arranged 0, 2, 3-4, those of each lateris arranged, two near a second lobe, and group of one or two near middle; lobes and plates all sometimes wanting; genacerores 3-4(9-13)8-17.—Algeria on Cypress.-----  
*striata* Newst.

## SPECIES OF HEMICHIONASPIS

- a. Pygidium of adult female with three pairs of lobes.
  - b. Pygidium with median pair of lobes small, scarcely projecting beyond distal end of second, each with single notch; second pair of lobes incised; third pair of lobes not incised; plates 0, 1, 1, 6, those of incisurae short, those of each lateris arranged 1-1-4; altaceratubae seven on each side; dorsal oraceratubae few; anus located cephalad of vulva; genacerores 1-12(20-23)20-23.—India on Thea.---  
*separata* Green.
  - bb. Pygidium with median pair of lobes large, extending slightly caudad of second pair; second pair of lobes incised, feebly chitinated, distinct, distal portion of lobelets expanded; third pair of lobes sometimes developed, incised, mesal lobelet longer than broad, lateral lobelet broader than long, margins of lobelets serrate; latadentes of second incisurae very prominent, longer than broad; plates arranged 0, 1, 1, 5-6, those of each lateris arranged 1-1to2-3; brevaceratubae few in number, large and oval; genacerores 8-10(20-23)17-23.—Ceylon on Carsia.-----*alatae* Ruth.
- aa. Pygidium with less than three pairs of lobes.
  - b. Pygidium with two pairs of lobes.
    - c. Pygidium without plates in each second incisura; distance between median lobe and second lobe greater than width of a median lobe; median pair of lobes large and prominent, minutely serrate or crenulate, hardly projecting; second pair of lobes small, incised, narrow, inconspicuous, scarcely projecting; plates moderately long, arranged 0, 0, 1, each lateris probably with more; dorsal oraceratubae few, large and conspicuous; mesospracerores represented by small group; genacerores 1-10(13-23)17-25.—Bengal, India on Ficus.-----*fici* Green.
    - cc. Pygidium with plates in second incisurae, if wanting, median and second pair of lobes not the width of a median lobe apart.
    - d. Pygidium with two median lobes together not as broad as long or at most subequal.
      - e. Pygidium with second pair of lobes incised, mesal lobelet projecting beyond smaller lateral lobelet; median pair of lobes long, projecting distinctly beyond distal ends of second pair, lateral margins with two notches or irregularly crenulate; plates arranged 0, 1, 6, those of each lateris arranged 1-1-1-3; prominent latadentis in each second incisura between plate and third lobe; dorsal oraceratubae few in number; genacerores 6-7(11-12)9-11.—Socotia Island on Dracaena. -----*dracaenae* Cooley.
    - ee. Pygidium with second pair of lobes not incised, longer than broad, hatchet-shaped, distal margin oblique; median

pair of lobes with mesal margins straight or slightly divergent, not adjacent, hatchet-shaped, longer than second lobe, lateral margin with two notches; plates small, arranged 0, 1, 3, those of each lateris arranged 1-1-1; margin with six altaceratubae on each side; brevaceratubae few in number, not in crescentic transverse rows; genacerores 2-4(8-13)8-15.—This species is given this place only because of its original reference.—North Australia on Pandanus. -----*pseudaspidistrae* Green.

- dd. Pygidium with two median lobes together broader than long.
- e. Pygidium with anus and vulva superimposed; median pair of lobes moderately produced, lateral margins oblique, two notches, forming three subequal crenulations; plates longer than lobes, arranged 0, 7, those of each lateris arranged 1-2-2-2; genacerores 12-18(15-19)13-17.—Natal, Africa on *Altermanthera*. -----*cyanogena* Ckll.
- ee. Pygidium with anus and vulva not superimposed.
- f. Pygidium with anus located cephalad of vulva.
  - g. Pygidium with median pair of lobes broader than long, margin strongly crenulate, with three depressions; second pair of lobes incised, mesal lobelet enlarged and subtruncate at distal end; third pair of lobes wanting; plates large; vulva located between postgenacerores and caudad of anus; genacerores 8-8 (23-23)12-15.—French Guinea, Africa on *Eleis*.-----*marchali* Ckll.
- gg. Pygidium with median pair of lobes projecting distinctly beyond distal end of second pair.
- h. Pygidium with three rows of brevaceratubae, about four oraceratubae in each half of each row; median pair of lobes large, crenulate, broader than long; second pair of lobes minute, incised; plates long, arranged 0, 2, 7, those of each lateris arranged 2-1-1-3; altaceratubae five on each side; genacerores 11-20(20-27)16-22; oblong chitinous thickening laterad of genacerores; mesospiracerores represented by conspicuous groups; insects living in small pits at base of veins on underside of leaves.—Ceylon on *Elaeocarpus*.-----*scrobicularum* Green.
- hh. Pygidium never with three rows of brevaceratubae, rarely with two partial rows.
  - i. Pygidium with genacerores 6-8(11-15)10-15; median pair of lobes prominent, crenulate; second pair of lobes small, incised; plates stout, longer than lobes, arranged 0, 1, 6, those of each lateris arranged 1-1-1-3; altaceratubae six on each side; brevaceratubae one on each side of fourth and three on each side of fifth row;

- mesospiracerores 3-4, metaspiracerores wanting; anus and vulva rarely superimposed.—Ceylon on *Rhododendron*.-----*rhododendri* Green.
- ii. Pygidium with genacerores 4-4(8-10)8-10; median pair of lobes large, dark colored, semicircular, margins dentate or crenulate with six small teeth, outer two very minute; second pair of lobes incised, lobelets longer than broad, distal end of mesal lobelet rounded and of lateral pointed; large plate cephalad of each second lobe and prominent latadentis bearing oracratuba on each side of plate; two obliquely truncated lobe-like projections with rounded angles adjacent to and cephalad of cephalic latadentis; plate adjacent to cephalic lobe-like projection and another at cephalic end of each lateris; dorsal brevaceratubae not described.—Philippine Islands on *Uvaria*.-----*uvariae* Ckll. & Robs.
- ff. Pygidium with anus located caudad of vulva.
- g. Pygidium with genacerores not 16-16(19-20)25-25.
- h. Pygidium without plates in each second incisura; scale of adult female long and narrow with sides subparallel, four to six times as long as wide; median pair of lobes indistinctly separated, broader than long, crenulate; second pair of lobes small, incised; plates short on caudal portion and long on cephalic, arranged 0, 0, 5, those of each lateris arranged 1-1-1-2; altaceratubae six on each side; brevaceratubae one on each fourth and three on each fifth row; genacerores 8-8(18-25)16-18; pregenacerores generally with largest number; mesospiracerores distinct and one metaspiraceroris.—India, Ceylon on *Thea*, *Psychotria*, *Eurya*.-----*theae* Mask.
- hh. Pygidium with one plate in each second incisura.
- i. Pygidium with 12-28 postgenacerores.
- j. Pygidium with cephalic altaceratubae of each side always distant from lateral brevaceratubae of fifth row; median pair of lobes indistinctly separated, broader than long, crenulate; second pair of lobes incised, mesal lobelet prominent, truncate; third pair of lobes obsolete; plates short on caudal and long on cephalic portion, arranged 0, 1, 5-6, those of each lateris arranged 1-1-1-2or3; altaceratubae six on each side, brevaceratubae one to two on each side of fourth and three to four on each side of fifth row; genacerores 4-16(11-22)12-28, postgenacerores al-

ways with largest number; mesospiracerores forming distinct group, sometimes with inconspicuous group of metaspiracerores.—Asia, Australia, France, England, eastern Canada and United States, California, West Indies, Brazil on *Aspidistra*, *Acacia*, *Davallia*, *Cocos*, *Cyanotus*, *Areca*, orchids, ferns, orange, fig, mango, pepper-tree, etc.-----*aspidistrae* Sign.

- jj. Pygidium with cephalic altaceratubae of each side adjacent to lateral brevaceratubae of fifth row.

k. Pygidium with median pair of lobes prominent, longer than broad, crenulate; second pair of lobes minute, prominent; third pair of lobes obsolete; plates comparatively short, arranged 0, 1, 5-6, those of each lateris arranged 1-1-1-2or3; altaceratubae six in number; brevaceratubae one on each fourth and one on each fifth row near an altaceratuba and double row of five or six cephalad of fifth row; genacerores 6-11(14-17)12-17; mesospiracerores represented by small group.—*Chionaspis albizziae* Green.—New Zealand, Japan, Ceylon, Florida, West Indies, Panama, Brazil on *Parsonia*, *Rhipogonium*, *Hibiscus*, *Capsicum*, *Melia*, *Azedarch*, *Cycas*, *Pelargonium*, *Albizzia*, *Agave*, fig, cocoa-palm, cotton, pepper, orange, etc.---  
*minor* Mask.

- kk. Pygidium with median pair of lobes broader than long; scale with exuviae darker than in type.—West Africa.-----

*minor strachani* Cooley.

- ii. Pygidium with genacerores 7-12(10-13)10-12; median pair of lobes scarcely projecting, two lobes together broader than long, strongly denticulate; second pair of lobes incised, lobelets narrow, equal in width, mesal longest; plates longer than lobes, arranged 0, 1, 1-1, others probably present on each lateris; anus approximately central in location; dorsal oraceratubae few; scale whitish, almost colorless, more or less translucent.—Bengal, India on *Ficus*.-----

*minima* Green.

- gg. Pygidium with genacerores 16-16(19-20)25-25; anus about nine times its width from caudal margin; median pair of lobes together broader than long, with four crenulations, first two very deep and strong; second pair of lobes quite rudimentary, not or hardly extending beyond general margin; plates arranged



0, 1, 3, those of each second incisura small, those of each lateris very large and long, placed at long intervals; caudal segment of preabdomen with three plates on each side; dorsal oraceratubae not numerous; scale pyriform, broad, varying to nearly circular, light grayish or yellowish.—This species may be wrongly associated, placed here because compared with theae and aspidistae.—Philippine Islands on *Gossypium*. -----townsendi Ckll.

bb. Pygidium with one pair of lobes.

c. Pygidium with plate adjacent to each median lobe.

d. Pygidium with genacerores 19-24(30-38)27-35; median pair of lobes large, prominent, broader than long, crenulate; other pairs of lobes obsolete; plates long and slender on cephalic part of each lateris, short on caudal part, arranged 0, 10-12, those of each lateris arranged 1-1-1-2-5or7; caudal preabdominal segment with 5-7 plates on each side; altaceratubae five on each side; brevaceratubae two on each fourth and five on each fifth row; mesospiracerores and metaspiracerores present.—Ceylon on *Mussaenda*, *Loranthus*, *Debregeasia*.-----  
*mussaendae* Green.

dd. Pygidium with genacerores 3-3(13-13)11-13; median pair of lobes together broader than long, not fused, each with about three notches or crenulations; plates all long, much longer than median lobes, arranged 0, 4, those of each lateris arranged, one adjacent to a median lobe, one in what would be a third incisura, one near middle of each lateris, and one at its cephalic end; caudal preabdominal segment with two plates on each side; spiracerores wanting; prominent latadentes bearing oraceratubae located on each side between two caudal plates; anus located slightly cephalad of vulva. Brazil. -----orlando Leon.

#### SPECIES OF PIENACASPIS

a. Pygidium with three or more pairs of lobes.

b. Pygidium with second pair of lobes not incised, short, broadly rounded, entire; median pair of lobes prominent, oblique, diverging, not confluent, crenulate; third pair of lobes small, slight extension of margin, rounded, entire; plates large, dagger-shaped, arranged 0, 1, 2, 2, those of each lateris distant, altaceratubae large, five on each side; spiracerores wanting; genacerores 12-12 (8-9)14-16.—Turkey on *Arthrocneumum*.-----arthrocneumi Lindgr.

bb. Pygidium with second pair of lobes always incised.

c. Pygidium always with plates in each second incisura.

d. Pygidium always with plates of lateres arranged in three groups.

e. Pygidium with one plate in median group of each lateris.

f. Pygidium with (25-34) pregenacerores present.

- g. Pygidium with cephalic group of each lateris with two plates, plates slender, arranged 0, 1, 1, 4, those of each lateris arranged 1-1-2; median pair of lobes moderately large, divergent, not confluent, entire; second and third pairs of lobes incised, mesal lobelet truncate and larger than lateral, lateral lobelets pointed, all entire; mesospiracerores present; brevaceratubae few in number; anus located less than its own width caudad of vulva, nine times its width from caudal margin; genacerores 16-16(25-33)16-23.—Ceylon on *Litsea*. -----*litzeae* Green.
- gg. Pygidium with cephalic group of each lateris with three plates, plates stout, dagger-shaped, arranged 0, 1, 1, 5, those of each lateris arranged 1-1-3; median pair of lobes large, divergent, confluent, distal ends scarcely projecting, minutely serrate; second and third pairs of lobes incised, mesal lobelets larger than lateral, all lobelets bluntly rounded, entire; mesospiracerores and metaspiracerores present; brevaceratubae well developed; anus located seven times its width from caudal margin and about its own width cephalad of vulva; genacerores 12-16(28-34)18-24.—Ceylon on *Psidium*, *Actinodaphne*. -----*megaloba* Green.
- ff. Pygidium with (10-23) pregenacerores present.
  - g. Pygidium with third pair of lobes small or wanting, incised, broad and short; median pair of lobes confluent at proximal end, serrate, large; second pair of lobes incised, mesal lobelet larger than lateral, extends caudad about as far as median pair; plates arranged 0, 1, 1, 5, those of each lateris arranged 1-1-3; altaceratubae three on each side, opening in latadentes; genacerores 7-9(17-23)23-34.—China, California at quarantine on palm.-----*cockerelli* Cooley.
  - gg. Pygidium with third pair of lobes large and well developed.
  - h. Pygidium with second pair of lobes incised, mesal lobelet distinctly larger than lateral, lobelets well developed, mesal lobelet broadly rounded and lateral bluntly pointed, entire or obscurely serrate; third pair of lobes large and well developed, incised, mesal lobelet distinct, lateral lobelet obscure or wanting; median pair of lobes large, well developed, divergent, confluent, scarcely projecting, serrate; plates dagger-shaped, those of second incisurae very short, arranged 0, 1, 1, 4-6, those of each lateris arranged 1-1-2or4; oraceratubae of brevaceratubae with 2-3 in mesal group of second row, third row 4-6 in mesal group and 2-4 in lateral, fourth row 4-8 mesal and 4-6 lateral; genacerores 6-13(10-17)10-16. — Kansas, Japan on *Rhus*, sycamore.-----*platani* Cooley.

- hh. Pygidium with second pair of lobes incised, mesal and lateral lobelets subequal in size, constricted at proximal end, distal end broadly rounded, entire; third pair of lobes incised, mesal lobelet distinctly larger than lateral, constricted at proximal end, distal end broadly rounded, entire; median pair of lobes long, strongly divergent, not confluent, serrate; plates longer than lobes, spine-like, arranged 0, 1, 1, 3, those of each lateris arranged 1-1-1; altaceratubae apparently seven on each side; latadentes with oraceratubae in second and third incisurae; lateres irregularly dentate with four marginal oraceratubae; genacerores 8-9 (16-17) 16-17, pregenacerores and postgenacerores of each side almost confluent.—Philippine Islands on *Mischocarpus*. ----- *mischocarpi* Ckll. & Robs.
- ee. Pygidium always with more than one plate in median group of each lateris.
- f. Pygidium with three plates in median group of each lateris.
- g. Pygidium with four plates in cephalic group of each lateris, plates long, slender, arranged 0, 1, 1, 8, those of each lateris arranged 1-3-4; median pair of lobes large, divergent, confluent, serrate; second and third pairs of lobes incised, lobelets prominent, mesal larger than lateral, constricted at proximal end, distal end bluntly rounded, entire; brevaceratubae numerous; mesospracerores present; anus ten times its width from caudal margin and about its own width cephalad of vulva; genacerores 10-16 (23-27) 27-60.—Ceylon on *Gelonium*.----- *varicosa* Green.
- gg. Pygidium with five plates in cephalic group of each lateris, plates arranged 0, 1, 1-2, 9-11, those of each lateris arranged 1 to 3-3-5; median pair of lobes moderate in size, divergent, confluent, serrate; second pair of lobes incised, mesal lobelet larger than lateral, projects farther caudad, sometimes exceeding median lobe; third pair of lobes not incised, sometimes rudimentary; altaceratubae four on each side, opening in latadentes; genacerores 8-14 (19-28) 19-33.—Japan on *Aucuba*. ----- *aucubae* Cooley.
- ff. Pygidium with two plates in median group of each lateris, plates long, dagger-shaped, arranged 0, 1, 1, 7, those of each lateris arranged 1-2-4; median pair of lobes large, confluent, divergent, crenulate; second and third pairs of lobes incised, lobelets subequal, rounded, entire; brevaceratubae numerous; anus about seven times its width from caudal margin and about twice cephalad of vulva; genacerores 4-6 (15-15) 30-30.—Samoa on palm. *samoana* Doane & Ferris.

- dd. Pygidium with plates of each lateris arranged in less than three groups.
- e. Pygidium with plates of each lateris arranged in two groups.
- f. Pygidium with plates of incisurae and lateres at least twice as long as lobes.
- g. Pygidium with genacerores 4-8(12-18)14-16; median pair of lobes rather small, divergent, distal ends broadly rounded, hardly projecting, confluent; second and third pairs of lobes greatly reduced in size, incised, lobelets distinctly separated, broadly rounded, entire, mesal lobelet larger than lateral; plates long, stout, three or more times as long as lobes, arranged 0, 1, 1, 2, those of each lateris arranged 1-1; altaceratubae four on each side.—*Chionaspis pinifoliae* heterophyllae Cooley.—Florida, Rhode Island on Pinus. -----*heterophyllae* Cooley.
- gg. Pygidium with genacerores 5-8(20-25)21-21; median pair of lobes large, prominent, divergent, confluent at proximal end, distal portions broad, broadly rounded, serrate; second and third pairs of lobes incised, mesal lobelet much larger than lateral, truncate, entire; plates long and slender, longer than lobes, arranged 0, 1, 1, 3, those of each lateris arranged 1-2; altaceratubae at least four times its width from caudal margin, probably cephalad of vulva.—Japan on Quercus. -----*kinshincensis* Knw.
- ff. Pygidium with plates of incisurae and lateres distinctly shorter than lobes, lobe-like, arranged 0, 1, 1, 2, those of each lateris arranged 1-1; cephalic one very broad with margin serrate; median pair of lobes long, deeply recessed, divergent, not confluent, coarsely serrate; second and third pairs of lobes incised, constricted at proximal end, distal portion dilated, broadly bluntly rounded, subequal in size, entire; latadentes in second and third incisurae and between plates of lateres, bearing large oraceratubae; vulva located between postgenacerores; altaceratubae apparently three on each side; brevaceratubae small and few in number; genacerores 7-8(10-14)8-11.—German East Africa on forest tree under fungus. -----*lutca* Newst.
- ee. Pygidium with plates of each lateris arranged in a single group.
- f. Pygidium with genacerores 10-10(22-26)19-26; median pair of lobes large, widely divergent, broader than long, confluent, serrate; second and third pairs of lobes incised, distal ends broadly rounded, subequal in size, entire; latadentes in second and third incisurae, bearing

oraceratubae; plates distinctly longer than lobes, spine-like, arranged 0, 1, 1, 1.—Natal on mango, palm.-----  
*natalensis* Ckll.

- ff. Pygidium with genacerores 5-5(20-21)38-39; median pair of lobes divergent, not confluent, hardly projecting; second and third pairs of lobes prominent, incised, mesal lobelets larger than lateral, projecting caudad of median lobes, broadly bluntly rounded, entire; plates dagger-shaped, twice or more as long as lobes, arranged 0, 1, 1, 1; altaceratubae apparently three on each side.—Dutch East Africa on *Dracaena*.-----*tangana* Lindgr.

- cc. Pygidium always without plates in second incisurae, plates spine-like, much longer than lobes, arranged 0, 0, 1, 1; median pair of lobes large, divergent, not confluent, broadly rounded, serrate; second and third pairs of lobes incised, lobelets broadly truncate rounded, entire, mesal lobelets larger than lateral, mesal lobelets of second pair projecting farther caudad than median lobes; setae of median incisura prominent, nearly as long as median lobes; anus located just cephalad of mesogenacerores, evidently cephalad of vulva; spiracerores apparently wanting; altaceratubae prominent, five on each side; genacerores 1-2(6-7)3-4.—French Guinea on *Macrobium*.-----  
*bussi* Newst.

aa. Pygidium always with less than three pairs of lobes.

b. Pygidium with two pairs of lobes.

- c. Pygidium with two plates in each second incisura, plates longer than lobes, arranged 0, 2, 4, those of each lateris arranged 2-1-1; median pair of lobes prominent, narrow, divergent, lateral margin convex, mesal margin concave on distal portion, distal end rounded, entire; second pair of lobes incised, prominent, mesal lobelet longer than lateral, slightly broader, proximal portion constricted, distal portion expanded, faintly notched, lateral lobelet not constricted or expanded or notched; altaceratubae large, five on each side; brevaceratubae conspicuous; anus and vulva superimposed, anus four times its width from caudal margin; genacerores 7-8(11-14)10-12.—India on *Oryza*.-----*decurvata* Green.

- cc. Pygidium always with less than two plates in each second incisura.

d. Pygidium with one plate in each second incisura.

e. Pygidium with postgenacerores always more than twenty.

- f. Pygidium with pregenacerores always sixty or more, genacerores arranged 30-30(63-63)60-70; median pair of lobes large, prominent, oblique, confluent at proximal end, serrate, distal end broadly rounded, entire; second pair of lobes incised, prominent, narrow, mesal lobelet largest, distal ends bluntly pointed, entire; prothorax with ventral transverse row of conspicuous oval scars; plates small, hardly longer than median pair of

lobes, arranged 0, 1, 6, those of each lateris arranged 1-1-4; mesogenacerores present; anus located near pregenacerores, apparently cephalad of vulva; dorsal oraceratubae very numerous.—India on *Ficus*, *Solanum*, *Thea*. -----manni Green.

ff. Pygidium with pregenacerores always less than thirty.

g. Pygidium never with more than three plates on each lateris.

h. Pygidium with genacerores 4-7(11-15)20-26; median pair of lobes low, broad, divergent, distant at proximal end, broadly rounded, serrate; second pair of lobes incised, mesal lobelet twice or more size of lateral, bluntly rounded, entire, lateral lobelet triangular, pointed, entire; plates long, stout, arranged 0, 1, 3, those of each lateris arranged 1-1-1; mesospiracerores 3-5.—South Africa on *Rhus*. -----lounsburyi Cooley.

hh. Pygidium with genacerores 6-9(11-20)29-46; mesospiracerores 5-6; plates slender, much longer than lobes.—South Africa on *Ekebergia*.-----lounsburyi ekebergiae Brain.

eg. Pygidium always with more than three plates on each lateris.

h. Pygidium with second row of brevaceratubae always with oraceratubae present.

i. Pygidium with second row of brevaceratubae with 2-3 oraceratubae present, third row with 3-4 mesal and 4-5 lateral, fourth row with 3-4 mesal and 4-6 lateral; median pair of lobes large, oblique, confluent at proximal end, distal end broadly rounded and entire, mesal margin faintly serrate; second pair of lobes large, prominent, entire, incised, mesal lobelet larger than lateral, bluntly pointed; plates stout, particularly those of lateres, arranged 0, 1, 5-9, those of each lateris arranged 1-1-lor2-2or4; genacerores 8-15(19-31)13-23.—California, Japan on *Wistaria*, *Alnus*, *Salix*.-----wistariae Cooley.

ii. Pygidium with second row of brevaceratubae always with more than three oraceratubae.

j. Pygidium with second row of brevaceratubae with nine oraceratubae present, other rows with numerous irregularly arranged oraceratubae; median pair of lobes distinct, distant, oblique, divergent, margins undulate or toothed; second pair of lobes not incised, mesal lobelet three times size of lateral, margins broadly rounded, entire; plates not prominent, arranged 0, 1, 5, those of each

lateris arranged 1-1-1-2; spiracerores well developed, 4-5 cerores in each group; anus about ten times its width from caudal margin and about twice cephalad of vulva; altaceratubae numerous, thirteen or more on each side, apparently not large; genacerores 11-14(16-20)23-31.—Algeria on *Ceratonia*.-----  
*ceratoniae* Marchal.

- jj. Pygidium with second row of brevaceratubae with four or five oraceratubae present, other rows distinct; median pair of lobes contiguous or confluent, divergent; second pair of lobes distinct, not incised; plates apparently 0, 1, 5, not well developed; spiracerores distinct, 2-3 cerores in each group; altaceratubae not numerous and not arranged in groups; genacerores 8-10(15-21)15-22.—Algeria on *Bupleurum*.-----*bupleuri* Marchal.

- hh. Pygidium with second row of brevaceratubae with oraceratubae wanting, third row with 5 mesal and 4 lateral pores, fourth row with 3-4 mesal and 5-6 lateral pores; median pair of lobes confluent, oblique, large, divergent, minutely serrate, not projecting strongly; second pair of lobes minute, incised, inconspicuous; plates stout, larger on cephalic part of lateres, arranged 0, 1, 6, those of each lateris arranged 1-1-1-3; abdomen and thorax with many conspicuous oval pores; anus near to, probably cephalad of vulva, eight times its width from caudal margin; mesospiracerores present; genacerores 10-10(18-20)22-22.—Ceylon on *Strobilanthus*.-----*strobilanthi* Green.

ee. Pygidium with postgenacerores always less than twenty.

f. Species found, so far as known, only in Africa.

- g. Pygidium with genacerores 3-4(5-12)13-18; median pair of lobes broader than long, distant, not oblique, not confluent, distal margin crenulate; second pair of lobes incised, triangular, small; plates long, slender, arranged 0, 1, 2, probably three distant plates on lateres; altaceratubae small; brevaceratubae present.—South Africa on mistletoe.-----*visci* Brain.
- gg. Pygidium with genacerores 8-12(14-17)12-15; median pair of lobes divergent, confluent at proximal end, not large, entire; second pair of lobes prominent, incised, mesal lobelet large, projecting farther caudad than median lobe, bluntly rounded, much larger than lateral lobelet; plates dagger-shaped, arranged 0, 1, 3, those of each lateris placed singly and

distant; altaceratubae not prominent; brevaceratubae not numerous.—South Africa on aloe, grass,-----  
humilis Brain.

ff. Species found in other parts of the world.

g. Pygidium with anus located cephalad of vulva.

h. Pygidium with four plates on each lateris, plates stout, arranged 0, 1, 5-6, caudal plates much shorter than cephalic, those of each lateris arranged 1-1-or2-2-or3; median pair of lobes small, divergent, serrate; second pair of lobes incised, mesal lobelet larger than lateral, entire, rounded, spatulate; brevaceratubae with two oraceratubae in each second row, third row with 4 in mesal and 3 in lateral group, fourth row with 5 mesal and 4 lateral; anus nine times its width from caudal margin and less than once cephalad of vulva; mesospiracerores present; genacerores 4-8 (9-16)11-18. — Ceylon on Eurycles, Myristica, mango. -----dilata Green.

hh. Pygidium with three plates on each lateris, plates dagger-like, arranged 0, 1, 3, those of each lateris arranged 1-1-1; median pair of lobes broad, not prominent, confluent at proximal end, divergent, slightly constricted at middle, distal end truncate, entire or faintly serrate; second pair of lobes incised, small, mesal lobelet largest, triangular; anus located eleven times its width from caudal margin and four times cephalad of vulva; brevaceratubae with three mesal oraceratubae and five lateral; genacerores 4-5(11-13)15-17.—Australia on Leptospermum. -----angusta Green.

gg. Pygidium with anus and vulva superimposed.

h. Pygidium with seven or more plates on each lateris.

i. Pygidium with genacerores 6-8(10-12)8-12; median pair of lobes large, oblique, confluent at proximal end, mesal margin serrate; second pair of lobes incised, mesal lobelet three times size of lateral; plates slender, arranged 0, 1, 7, those of each lateris arranged 1-1-1-4; anus and vulva superimposed, anus five times its width from caudal margin.—North Carolina on Nyssa. -----nyssae Comst.

ii. Pygidium with genacerores 7-8(14-19)14-16; median pair of lobes large, oblique, confluent at proximal end, mesal margins serrate; second pair of lobes incised, mesal lobelet larger than lateral, margins entire; plates longer than lobes, arranged 0, 1, 8, those of each lat-



eris arranged 1-1-1-6; anus and vulva probably superimposed, anus eight times its width from caudal margin, located on line between pre-genacerores and postgenacerores; brevaceratubae with oraceratubae prominent, second row with 1 oraceratuba, third row with 4 mesal and 5 lateral, fourth row with 4 mesal and 4 lateral, and fifth row with 4 mesal and 6 lateral; altaceratubae large, prominent, six on each side; mesospiracerores present.—*Chionaspis candida* Banks.—Philippine Islands on Cocos. -----*inday* Banks.

- hh. Pygidium with four plates on each lateris, plates dagger-shaped, arranged 0, 1, 4, those of each lateris arranged 1-1-1-1; median pair of lobes prominent, oblique, confluent at proximal end; second pair of lobes incised, mesal lobelet much larger than lateral, distal portion bluntly rounded, entire; altaceratubae prominent, six on each side; genacerores 6-6(14-15)10-11.—Italy on asparagus...  
*berlesii* Leon.

- dd. Pygidium without plates in second incisurae, plates slender, increasing in size toward cephalic end of lateres, arranged 0, 0, 7, those of each lateris arranged 1-1-1-4; median pair of lobes large, prominent, projecting, bluntly rounded, broader than long, minutely serrate; second pair of lobes incised, small, triangular, entire, mesal lobelet slightly larger than lateral; brevaceratubae with oraceratubae of third row with 4 mesal and 5 lateral oraceratubae; altaceratubae five on each side; anus located near mesogenacerores, evidently cephalad of vulva, about twelve times its width from caudal margin; genacerores 10-12(25-26)20-27.—Ceylon on *Artocarpus*. -----*subcorticalis* Green.

- bb. Pygidium with a single pair of lobes, divergent, forming narrow margin to pygidial incisura, distal ends prominent and broadly truncate; plates dagger-shaped, arranged 0, 4, those of each lateris arranged 1-1-1-1, plate adjacent median lobe small; brevaceratubae with oraceratubae of third, fourth, and fifth rows arranged 4 mesal and 4-5 lateral; anus six times its width from caudal margin, located near mesogenacerores, evidently cephalad of vulva; mesospiracerores about 10; dorsum of mesothorax with transverse row of sharply pointed, hooked spines with dilated bases and three or four similar spines on ventral aspect caudad of each metaspiracle; genacerores 4-6(10-16)24-28.—New South Wales on *Eucalyptus*. -----*formosa* Green.

#### SPECIES OF CANASPIS

Body of adult female ovate, broadest through mesothorax; lateral margins of mesothorax and metathorax with one or two conical processes provided with ceratubae; pygidium with median pair of lobes small,

divergent, pointed, irregularly dentate; second pair of lobes incised, minute, inconspicuous; plates stout, arranged 0, 1, 3, those of each lateris arranged 1-1-1-0-0; genacerores 3-4(6-6)8-8; spiracerores wanting; anus located slightly cephalad of vulva.—Ceylon on *Arundinaria*.—  
*arundinariae* Green.

SPECIES OF COOLEYASPIS

Body greatly elongated, length four times its width, thorax two and one-half times as long as wide; median pair of lobes rounded, not oblique, serrate; second pair of lobes incised, mesal lobelet much larger than lateral, prominent, projecting farther caudad than median pair, margin of lobelets rounded at distal end, entire; plates spine-like, arranged 0, 1, 4, those of each lateris arranged 1-1-1-1; genacerores 4-5(8-10)23-30; mesospiracerores 4-5, metaspiracerores wanting; brevaceratubae prominent on pygidium and preabdomen; anus eight times its width from caudal margin; cephalad of anus transverse group of 14-15 genaceroris-like pores.—Uganda, Africa.-----  
*praclonga* Newst.

SPECIES OF SINISTRASPIS

Body with sinistral margin of preabdominal segments bearing large spine-like setae on prominent tubercles, each with brevaceratuba; pygidium with deep pygidial incision; median pair of lobes oblique, mesal margins oblique, finely serrate; second pair of lobes incised, mesal lobelet longer than broad and projecting caudad of median pair of lobes, distal end bluntly rounded, entire, lateral lobelet similar in shape to mesal, smaller; plates few in number, arranged 0, 0, 3, those of each lateris arranged 1-1-1; altaceratubae eight on each side; spiracerores wanting; anus nearly twelve times its width from caudal margin; genacerores 0-2(5-6)5-8.—Barbados on palm (?*Thrinax*).-----  
*unilateralis* Newst.

SPECIES OF AUGULASPIS

Pygidium of adult female with deep angular pygidial incision; median pair of lobes small, each forming the end of a projection limiting one side of pygidial incision, longer than broad, bluntly pointedly rounded; other pairs of lobes wanting; plates arranged 0, 2-3, those of each lateris located one near median lobe and two or three near cephalic end, plates small, blunt, rudimentary; brevaceratubae forming two distinct broad bands; anus located near mesogenacerores, vulva located slightly caudad of anus; mesospiracerores and metaspiracerores forming more or less crescentic group of many cerores; marginal and submarginal altaceratubae present; genacerores 26-26(19-22)32-44.—German East Africa.-----  
*nudata* Newst.

SPECIES OF GRAMENASPIS

Pygidium with median pair of lobes low and broad, broader than long, rounded, entire; second and third pairs of lobes incised, mesal lobelet much larger than lateral, approximating median lobe in size, all entire, broadly rounded; plates wanting in all incisurae and on lateres;

anus located between postgenacerores; dorsal oraceratubae arranged in two short series; mesospiracerores 4-5; setae longer than lobes; genacerores 14-14(18-19)16-18.—South west Africa on "grass-like plant." -----*africana* Newst.

## SPECIES OF CONTIGASPIS

- a. Pygidium with genacerores 8-9(12-14)13-15; median pair of lobes short, broad, broader than long, adjacent, sometimes appearing as if fused; other lobes wanting; plates wanting; setae adjacent each median lobe very long, others on lateres shorter; lateres irregularly crenulate; marginal and submarginal altaceratubae present; dorsal oraceratubae numerous and extending to margin; anus located between postgenacerores; mesospiracerores 4, metaspiracerores wanting.—Southwest Africa. -----*subnudata* Newst.
- aa. Pygidium with genacerores 2-4(9-12)14-22; median pair of lobes distinct, fused at proximal end, lateral margin oblique, longest, distinct lateral notch, mesal margin oblique; setae about as long as lobes; plates wanting; lateres irregularly crenulate; altaceratubae small, seven on each side, arranged 2-2-3; anus and vulva not described.—South Africa on *Scutia*.-----*scutiae* Brain.

## SPECIES OF NATALASPIS

Pygidium without lobes or plates, margin coarsely corrugate or undulate, mesal portion prolonged, rounded; setae normal in size; oraceratubae not abundant; genacerores 18-25(24-32)48-60.—Adult female contains well developed embryos.—*Chionaspis simplex* Brain (not Green).—Natal, Africa on bamboo.-----*simplex* Brain.

## SPECIES OF PARACHIONASPIS

Pygidium with median pair of lobes prominent, conical processes, projecting, mesal margins entire, lateral serrate; second pair of lobes incised, lobelets serrate, subequal, each subequal to a median lobe, mesal margin of mesal lobelets entire, lateral margin and both margins of lateral lobelets serrate; plates minute, arranged 0, 1, 3, shorter than lobes, those of each lateris arranged 1-1-1; lateres with deep indentations; genacerores 18-22(24-32)20-30; mesospiracerores and metaspiracerores present; altaceratubae apparently three on each side; brevaceratubae promiscuously arranged; anus more than its own width cephalad of vulva; forming galls on young stems, petioles and mid-ribes of leaves.—Ceylon on *Hedyotis*. -----*galliformens* Green.

## SPECIES OF PARLATOREOPSIS

Antennae with single strongly curved and deeply forked spine; pygidium with median pair of lobes large, bluntly rounded, mesal notches wanting, two lateral notches; second pair of lobes smaller, as long as broad, not incised, mesal margin straight, lateral margin obliquely rounded, notched or dentate; plates arranged 0, 0, 2, plates located near but not adjacent to second pair of lobes, appear like incised third lobe, not longer than lobes, bluntly pointed; setae very long, particularly those of cephalic half of each lateris; each lateris with two

prominent latadentes; vulva located near middle of pygidium, anus between vulva and caudal margin; genacerores single, transverse curved row of three or four cerores; insects insinuate themselves beneath cuticle of food-plant.—Egypt on *Justicia*.-----*longispina* Newst.

SPECIES OF POLIASPIS

- a. Pygidium with nine groups of genacerores, arranged 1-1(18-21)25-35, four other groups forming cephalic arch, lateral group of each side 8-12, two mesal groups 1-2 cerores; brevaceratubae numerous; median pair of lobes minute, scarcely perceptible; apparently without plates.—Australia on *Exocarpus*, *Santalum*, *Leptospermum*, *Ixylobium*, *Dillwynia*.-----*exocarpi* Mask.
- aa. Pygidium with less than nine groups of genacerores.
  - b. Pygidium with eight groups of genacerores.
    - c. Pygidium with three pairs of lobes.
      - d. Pygidium with second and third pairs of lobes not incised, lobes similar in form, second pair smaller than median and larger than third pair; median pair of lobes broad, broadly rounded, distant, not divergent or confluent, entire; plates apparently wanting; genacerores in eight groups, arranged 10-10(10-12)12-12, three other groups in cephalic transverse arch, mesal group of about 10 and lateral groups of about 4 cerores; brevaceratubae numerous.—Japan on *Pinus*, *Abies*.--  
*pini* Mask.
      - dd. Pygidium with second and third pairs of lobes incised, lobelets subequal, all minute, blunt, triangular, second pair of lobes represented by three lobelets, cephalic lobelet probably latadentis; median pair of lobes long, projecting, longer than broad, blunt, subtriangular, mesal and lateral notches, distant, not divergent, not confluent; plates long and slender, arranged 0, 0, 1, 1; genacerores in eight groups, arranged 3-5(9-14)20-25, other groups in transverse row, mesal group of 2-4, each lateral group of 7-8.—West Australia on leguminous plant.-----*intermedia* Fuller.
  - cc. Pygidium with less than three pairs of lobes.
    - d. Pygidium with two pairs of lobes.
      - e. Pygidium with median pair of lobes confluent at proximal end.
        - f. Pygidium with second pair of lobes incised, rounded, margins entire, mesal lobelet larger than lateral; median pair of lobes confluent, at proximal end, large, slightly divergent, finely and widely serrate or entire; plates slender, arranged 0, 1, 1, 8-10, caudal plates longer and more slender than cephalic, those of each lateris arranged 1-1-1-5to7, caudal group short and broad at proximal end; genacerores arranged in eight groups, 2-4(10-13)21-25, other three groups in transverse row, each group 2-4; mesospracerores about 12, metaspracerores 4-6; altaceratubae seven on each side;

anus located on line drawn through cephalic end of postgenacerores.—District of Columbia, England on Cycas, Dion, palms.-----*cycadis* Comst.

- ff. Pygidium with second pair of lobes small, not incised, long, narrow, finely serrate; median pair of lobes narrow, divergent, confluent at proximal end, serrate; plates four on each side of median lobes, simple, spine-like, caudal three situated between median lobes and third row of brevaceratubae, arranged 0, 0, 4; brevaceratubae with 2 oraceratubae in second row, third row with 4-6 mesal and 5-7 lateral, fourth row with 4-5 mesal and 6-7 lateral, and fifth row with 5 mesal and 6 lateral oraceratubae; anus located near mesogenacerores, seven times its width from caudal margin and about twice cephalad of vulva; mesospiracerores 6-10, metaspiracerores 4-6; genacerores in eight groups, 2-4(14-20)21-25, three cephalic groups of 2-5 each.—New South Wales on Coprosoma.-----*argentosis* Brittin.
- ee. Pygidium with median pair of lobes as far apart as width of a median lobe.
- f. Pygidium with plate in each second incisura, plates twice as long as lobes, arranged 0, 1, 2; median pair of lobes distant, distal margin rounded, serrate; second pair of lobes incised, mesal lobelet twice as large as lateral, projecting slightly beyond median, distal end blunt, lateral lobelet triangular; brevaceratubae prominent; genacerores in eight groups, 2-5(11-17)17-27, three groups cephalad of mesogenacerores, distant, in transverse row, 3-4 cerores.—Natal on Carissa.-----*carissae* Ckll.
- ff. Pygidium without plates in second incisurae, plates small, inconspicuous, arranged 0, 0, 2; median pair of lobes rounded, broad, distant, angles rounded, margins entire; second pair of lobes small, incised, mesal lobelet slightly larger than lateral, triangular, entire; each lateris with triangular lobe-like projections, arranged in pairs; mesospiracerores 6-10; genacerores in eight groups, arranged 1-10(14-20)23-36, three cephalic groups of 4-9, 1-6, and 5-8 cerores.—Natal, Africa on Kiggelaria, willow.-----*kiggelariae* Brain.
- dd. Pygidium with single pair of lobes; median pair of lobes long, broad, divergent, not confluent, apparently entire; plates apparently wanting; three or four large setae on each side may be plates; brevaceratubae represented by three distinct rows, third to fifth, on each side; anus about six times its width from caudal margin and nearly twice cephalad of vulva; lateres irregular; genacerores in eight groups, arranged 4-6(20-30)20-30, three other groups in trans-

verse row, mesal group of row 3-5, each lateral group 8-10.  
—New Zealand on Veronica, Leucopogon, Cyanthodes, ferns....

- bb. Pygidium with seven groups of genacerores, arranged 3-4 (15-17) 16-20, and a group cephalad and in line with pregenacerores, 7-8; median pair of lobes prominent, divergent, confluent, short, wide, entire; second pair of lobes minute, triangular, entire; plates much longer than lobes, arranged 0, 1, 1; lateres serrate.—West Australia on Daviesia.....*nitens* Fuller.

SPECIES OF POLIASPOIDES

Pygidium of adult female without lobes or plates; margin with three indentations, limited on cephalic side by latadentes; lataceratubae apparently wanting; brevaceratubae irregularly arranged; ventral surface with numerous small pores adjacent to margin; dorsal and ventral surfaces coarsely carinated; genacerores 19-22 (30-35) 50-55, two groups caudad of postgenacerores, each consisting of 1-3 cerores; anus located cephalad of vulva, near cephalic margin of mesogenacerores and vulva between postgenacerores; scale of adult female mussel-shaped.—Ceylon on bamboo.....*simplex* Green.

SPECIES OF CRYPTASPIDUS

Pygidium of adult female with median lobes short and broad, broader than long, distal margin with notches and roundly produced between them; second pair of lobes small, incised, mesal lobelet largest, two notches on distal margin, lateral lobelet entire; plates large, twice as long as lobes, arranged 2, 1, 2, those of each lateris located one near second lobe and one near middle, remainder of each lateris not figured or described; 8 long dorsal setae and 6 much shorter ventral setae; latadentes with oraceratubae in each second incisura between plate and second lobe and cephalad of caudal plate of lateres; mesospiracerores 4-7; lateres dentate, irregular; genacerores 6-8 (14-17) 9-13.—Madagascar on Cocos. ....*nucum* Lindgr.

SPECIES OF CRYPTODIASPID

- a. Pygidium of adult female with plates, never with pectinae, arranged 0, 1, 1, 6-7, those of each second and third incisura large, much longer than lobes; median pair of lobes narrow, bluntly pointed, serrate; second and third pairs of lobes incised, lateral lobelets smaller than mesal, all lobelets notched; two altaceratubae on each side opening in prominent latadentes in second and third incisurae; genacerores 4-4 (8-10) 6-8; second nymphal female with three pairs of lobes and deep pygidial incision; median pair of lobes oblique, mesal margins serrate, not projecting; second and third pairs of lobes incised, broadly truncate; plates arranged 0, 1, 1, 2-3; altaceratubae four on each side opening in latadentes.—Kamerun, Africa on Euphorbiaceae. ....*conservans* Lindgr.
- aa. Pygidium of adult female with furcapectinae in second and third incisurae; median pair of lobes small, bluntly rounded, faintly notched on mesal margin; second and third pairs of lobes deeply

incised, mesal lobelet much longer and broader than lateral and truncate; furcapectinae and plates arranged 0, 1, 1, 5, furcapectinae adjacent to lobes and two or three times as long; altaceratubae wanting; genacerores 4-4(10-10)8-10; second nymphal female with four pairs of lobes and deep pygidial incision; median pair of lobes located in pygidial incision, oblique, mesal margins serrate; second, third, and fourth pairs of lobes incised, mesal lobelet much larger than lateral, entire, truncate; plates only present, arranged 0, 1, 1, 1, 1, 0, subequal in length to lobes; altaceratubae four on each side, large, opening in latadentes in second, third, and fourth incisurae and beyond fourth lobes; latadentes nearly as large as mesal lobelets.—Kamerun on *Macrolobium*.-----*hamata* Lindgr.

## SPECIES OF FURCHADASPIS

Scale of adult female circular; pygidium of adult female with median pair of lobes distant, divergent, subprojecting, finely and widely serrate; second and third pairs of lobes subequal, incised, lobelets with broadly rounded margins, entire or faintly notched, mesal lobelet larger than lateral; pectinae and plates short and stout, arranged 2, 1, 1, 11-12, those of insurae and cephalad of third pair of lobes bifurcate pectinae, others plates, those of each lateris arranged 1-1-2-3or4-2or 3-1; genacerores wanting; mesospiracerores and metaspiracerores 3-6, latter fewer in number; brevaceratubae numerous, irregularly arranged; anus located slightly cephalad of middle of pygidium.—England, Portugal, Italy, New York, Massachusetts, Bermuda on *Zamia*, *Cycas*.-----*zamia* Morgan.

## SPECIES OF MITULASPIS

Pygidium small; median pair of lobes large, distant, not divergent, not confluent, striate, faintly serrate, mesal and lateral margins converging, bluntly pointed, constricted at proximal end; second pair of lobes incised, mesal loblet three or more times as broad as lateral, similar to median in form, smaller; third pair of lobes small, incised; plates spiniform, longer than lobes, arranged 2, 2, 2, 3, those of each lateris arranged 1-1-1, distant from third lobe; anus twenty or more times its width from caudal margin and about once cephalad of vulva; mesospiracerores 5-6, metaspiracerores 2-3; altaceratubae not clearly indicated, 3 on each side.—Uganda, Africa on *Funtumia*.-----*funtumiae* Newst.

## SPECIES OF DENTACHIONASPIS

Pygidium with median pair of lobes small, incised, lobelets subequal, pointed, lobes distant, twice width of lobes apart; second pair of lobes lobe-like, larger than median pair, not incised, notched, bluntly rounded; furcapectinae sometimes plates, twice as long as lobes, arranged 0, 1, 5, those of each lateris arranged 1-2-2; anus located near cephalic end, vulva slightly cephalad of middle; dorsal oraceratubae in groups; mesospiracerores 9-11, generally arranged in two or three groups, metaspiracerores 2; altaceratubae three on each side in two groups, 1-2.—Transvaal, Africa on *Acacia*.-----*capensis* Newst.

SPECIES OF INCHOASPIS

*Pygidium* of adult female with minute median lobe located on each side of pygidial incision, triangular, entire, with a prominent oracera-tuba at its proximo-mesal angle; second, third, and fourth pairs of lobes incised, mesal lobelet at least twice as large as lateral, margin broadly rounded, lateral lobelet more angular with an irregular margin; plates longer than lobes, arranged 0, 1, 0, 2, 1, those of each lateris adjacent to a fourth lobe, there may be others; second and third incisurae with two minute adjacent triangular projections, probably latadentes; dorsal oracera-tubae numerous, in rows; spiracerores wanting; altaceratubae present; second exuvia of female with deep transverse thoracic constriction.—Southwest Africa.....  
*amaniensis* Lindgr.

SPECIES OF GRAPHASPIS

*Pygidium* of adult female with three pairs of lobes; median pair of lobes fully projecting, curved, divergent, mesal margin finely serrate, lateral margin entire; second and third pairs of lobes incised, lobe-lets similar, bluntly pointed, mesal lobelets of second pair of lobes projecting farther caudad than median pair of lobes; plates small, not much longer than lobes, arranged 0, 1, 1, 4, those of each lateris arranged 1-1-2; altaceratubae seven on each side; brevaceratubae fairly numerous, irregularly arranged; genacerores wanting; anus and vulva superimposed; scale of adult female pyriform.—Ceylon on *Antidesma*. .....*permutans* Green.

SPECIES OF AMETROCHASPIS

Scale of adult female short, pyriform; *pygidium* with three pairs of lobes; median pair of lobes divergent, not projecting, elongate, placed in pygidial incision, serrate; second and third pairs of lobes incised, lobelets constricted at proximal end, distal end broadly rounded, margins entire, mesal lobelet larger than lateral; plates distinctly longer than lobes, arranged 0, 1, 1, 4, those of each lateris arranged 1-1-2; altaceratubae eight on each side; brevaceratubae numerous, irregularly arranged; genacerores wanting; mesospiracerores represented by small group of pores; anus and vulva superimposed.—Ceylon on *Antidesma*. .....*flava* Green.

SPECIES OF PRONTASPIS

- a. *Pygidium* with median pair of lobes with lateral and mesal margins serrate, divergent, lateral margins subparallel; second and third pairs of lobes small, subequal, incised, serrate; setae short; plates arranged 0, 1, 1, 3, each lateris with a plate near a third lobe, one at cephalic end, and one midway between these two; preabdomen with caudal segment with 5-6 plates; anus broader than long, about fifteen times its width from caudal margin and about twice caudad of vulva; altaceratubae about four on each side.—Southern States, West Indies, Mexico, New Zealand, Australia, Japan, Samoa on *Euonymus*, *Osmanthus*, orange, palms. ....*citri* Comst.
- aa. *Pygidium* of adult female with all lobes entire; median pair of lobes distant, divergent, distal end round; second and third pairs of



lobes incised lobelets of second pair larger than those of third, mesal lobelet of both pairs larger than their lateral lobelets; plates slightly longer than lobes, arranged 0, 1, 1, 10-11, those of each lateris arranged 1-1-3-5 or 6; latadentes bearing oraceratubae located in median, second, and third incisurae, one just cephalad of each third lobe and near middle of lateres; spiracerores wanting.—Canary Islands on Euphorbia. -----*barrancorum* Lindgr.

## SPECIES OF REMOTASPIS

Scale of adult female white, highly convex, mytilaspiform; exuviae orange-red; cuticle of body, including pygidium, soft and thin; pygidium with median pair of lobes widely separated, as broad as long, broadly rounded, entire except for a distal notch; second pair of lobes incised, mesal lobelet similar in form but larger than a median lobe, lateral lobelet much smaller than mesal, one or two deep notches, so that lobelet appears to have two or three teeth; third pair of lobes deeply notched, mesal lobelet similar in size and form to a median lobe, lateral lobelet smaller, dentate; triangular latadentis caudad of each second lobe and three toothed ones cephalad of third lobe; altaceratubae four on each side; plates limited to one in each second incisura, arranged 0, 1, 0, 0; dorsal aspect with two broad bands of oraceratubae; anus located opposite "distal ends" of dorsal oraceratubae.—Uganda, Africa on unknown shrub.-----*dentilobis* Newst.

## SPECIES OF ASYMMETRASPIS

- a. Pygidium with second pair of lobes nearly as large as median pair, lateral margin oblique, not incised; median pair of lobes large, broader than long, mesal margins oblique, divergent, distant, distal margins sometimes dentate, subadjacent; dorsal oraceratubae few, in two transverse crescentic rows; plates inconspicuous, arranged 0, 0, 2-3, frequently broken; mesospiracerores 4-5; body with cephalic half strongly chitinized, caudal half including pygidium not strongly chitinized, line between two areas sharply marked; setae small, arranged two in median incisura, one in each second, and one on cephalic part of each lateris; four submarginal setae cephalad of lobes; anus eleven times its width from caudal margin and nearly four times cephalad of vulva.—Transvaal, Africa.-----*distorta* Newst.
- aa. Pygidium with second pair of lobes always smaller than median pair.
  - b. Pygidium with median pair of lobes serrate, broader than long, short, very distant; second pair of lobes incised, mesal lobelet larger than lateral, longer than a median lobe, much narrower, bluntly rounded, entire, lateral lobelet subtriangular, generally notched on both margins; plates long, slender, arranged 0, 1, 2, those of each lateris located one near second lobe, other at cephalic end; surface with several large clear vacuole-like oval areas; mesospiracerores 1-3, mesosperitreme depressed; surface of cuticle reticulate; altaceratubae apparently five on each side; brevaceratubae distinct; anus over twelve times its width from caudal margin.—Uganda, islands of Lake Victoria, Africa.-----*tenuidiscutis* Newst.

- bb. Pygidium with median pair of lobes entire, about as broad as long, mesal and lateral margins subparallel, distal end broadly rounded; second pair of lobes minute, inconspicuous, not incised, distal end with two notches; plates not longer than lobes, arranged 0, 0, 7, those of each lateris arranged 1-1-1-(2-2); altaceratubae apparently not prominent; brevaceratubae distinct; mesospiracerores 3-4, metaspiracerores wanting; anus located about eighteen times its width from caudal margin and about three times cephalad of vulva; body elongate; caudad of and in line with antennae, on each side a row of two or three blunt spiny processes and pair of long setae.—Uganda, islands of Lake Victoria, Africa on unknown tree.-----*dura* Newst.

SPECIES OF OBLUCTASPIS

- Pygidium with median pair of lobes minute, inconspicuous, distal end concave, mesal angle prolonged, sides parallel; second pair of lobes smaller than median, triangular, pointed, lateral margin oblique; plates small, short, broadened at proximal end, arranged 0, 1, 2, those of each lateris distant; brevaceratubae small, smaller than lamaceratubae, promiscuously arranged; anus eight times its width from caudal margin and three times cephalad of vulva.—New Mexico on Quercus. -----*lobata* Ferris.

SPECIES OF SITULASPIS

- Pygidium with median pair of lobes large, prominent, broader than long, distant, broadly rounded, lateral notch; second pair of lobes adjacent to median pair, minute, bluntly rounded, as long as broad, one-fifth width of median; plates slightly longer than median pair of lobes, broadest at proximal end, arranged 0, 0, 1, adjacent second lobe; altaceratubae wanting; brevaceratubae promiscuously arranged; anus located four times its width from caudal margin and six times caudad of vulva; setae small.—Arizona on Condalia.-----*condaliae* Ferris.

SPECIES OF KUWANASPIS

- Scale of adult female very long and slender, sides parallel and usually straight; second exuvia distinct; pygidium with median pair of lobes short, divergent, slightly notched on mesal margin; latadentes rounded, serrate; plates large, much longer than median lobes, arranged 0, 3, those of each lateris placed one near a median lobe, one near where third incisura would be located, and one midway between caudal and cephalic plates; anus located cephalad of middle of pygidium; dorsal oraceratubae numerous on caudal portion; latadentes few in number.—Japan on Phyllostachys. -----*hikosani* Knw.

SPECIES OF INCISASPIS

- Pygidium with median pair of lobes distant, broadly divergent, projecting, oblique mesal margin with four to six notches; plates placed near median pair of lobes, caudal three of each side shorter than others, about 12 on each side, stout, blunt, usually curved; setae on dorsal aspect 6, minute; mesospiracerores 2.—South Africa on Mitragnye.-----*pugionifera* Lindgr.

## SPECIES OF CORONASPIS

- a. Pygidium with median pair of lobes rounded, not tricuspid; two or three pairs of minute inconspicuous bluntly lanceolate lobes, median pair simple, second pair incised; plates prominent, arranged 0, 1, 8, those of each lateris arranged 1-1-1-1-4; dorsal oracratubae large, conspicuous, arranged in more or less definite rows; anus broader than long, about eight times its width from caudal margin; body after gestation reddish and densely chitinous; antennae consisting of corona-like area bearing four to six stout spines and central curved seta; caudad of each antenna and scattered over thoracic region oval translucent spaces; margin of preabdominal and caudal thoracic segments with numerous oracratubae, obscure in densely chitinous individuals; scale of adult female white, sometimes tinged with ochreous, exuviae reddish, sides of scale sloping up and forming median longitudinal rounded ridge.—Ceylon on undetermined tree.-----*coronifera* Green.
- aa. Pygidium with median pair of lobes small, mesal and lateral margins subparallel, distal end tricuspid; second pair of lobes incised, mesal lobelet large, lobe-like, much larger than a median lobe, margin rounded, entire, lateral lobelet tricuspid, similar in form to a median lobe; plates slender, longer than lobes, arranged 0, 1, 2, those of each lateris located one near second lobe and other at cephalic end; altaceratubae 5-6 on each side; lateres serrate between altaceratubae; antennae adjacent cephalad of head skeleton, each corona-like, margin with long spiny process, two longer than others, and two long setae; mesospiracerores 3, mesopitreme very large and depressed; scale of adult female elongate, strongly convex, pure glistening white, finely laminate, exuviae orange yellow to orange brown; male scale strongly carinate, secretory portion dull gold color.—Uganda, islands of Lake Victoria, Africa.-----*auratilis* Newst.

## SPECIES OF DENTASPIS

Scale of adult female satiny-white, transversely striate, striae equidistant and distinct, sides subparallel; body with cephalic region narrowed; pygidium with median pair of lobes distant, not located in pygidial incision, projecting, distal margin deeply serrate; second pair of lobes distant from median pair twice its width, similar in form, smaller, incised, deeply serrate; third pair of lobes only slight projection on margin, serrate, not incised; plates longer than lobes, arranged 0, 1, 1, 1-2, those of each lateris near third lobe; altaceratubae with tubes about as long as wide, arranged two cephalad of plate in second incisura, one associated with each second lobe and one near each third lobe.—Uganda, Africa on palms.---*substriata* Newst.

## SPECIES OF HOWARDIA

Scale of adult female broadly oval, caudal end narrowed, often almost circular, exuviae terminal; pygidium with median pair of lobes large, prominent, mesal angle roundly protuberant, lateral margin finely serrate, mesal margin substraight, not adjacent; second pair of lobes not incised, small, bluntly pointed, entire; lateres with serrate pro-

jections; plates stout, arranged 2, 2, 18-20, those of each lateris arranged 3-3or4-4or5-6; mesospiracerores and metaspiracerores present; brevaceratubae numerous, irregularly arranged; paraphyses club-shaped, two or three times as long as median pair of lobes, cephalic end of each enlarged, knob-like, extending from median incisura; anus located its own width cephalad of vulva.—Eastern United States, California, West Indies, Mexico, England, Ireland, Hawaiian Islands, Ceylon, Mauritius, Japan, Tahiti on orange, lime, tea, tamarind, Flacourtia, Cinchona, Ochrea, Ficus, Anona, Hibiscus, Microglossa.-----  
*biclavis* Comst.

SPECIES OF PROCERASPIS

Scale of adult female elongate, narrow, flat, more or less distinct median carina; body of adult female elongate, thorax occupying nearly three-fourths of length of body, metathoracic spiracles located near middle of caudal half; pygidium with median pair of lobes contiguous, two lobes together much broader than long, lateral margins oblique, minutely serrate; plates near median lobes smaller than those near cephalic end, arranged 0, 7, those of each lateris arranged 1-1-1-1-3; latadentis on each side between caudal first and second plates and two between second and third; paraphyses club-shaped, short, extending to margin near lateral proximal angle of each median lobe; dorsal oraceratubae wanting; lateres irregularly indented; anus approximately central in position.—Ceylon on Cinnamomum.-----  
*cinnamomi* Green.

SPECIES OF MARCHALASPIS

Pygidium with median pair of lobes distinct, entire, proximal portion strongly constricted, distal portion broadly rounded; second and third pairs of lobes incised, entire, lobelets subequal in size, similar in form, proximal portion strongly constricted, distal portion truncately rounded; median, second, and third incisurae each with triangular projection about as long as lobes, each identified as a plate; each lateris with six or more lobe-like serrate projections; altaceratubae 9 on each side; dorsal oraceratubae few, poorly developed and indistinct; anus located midway between vulva and caudal margin.—Guinea on Copaifera. -----  
*vuilleti* Marchal.

SPECIES OF CUPIDASPIS

Pygidium with median pair of lobes small, mere prominences, broadly rounded, entire; second pair of lobes not incised, large, not projecting strongly, broadly rounded, entire; pectinae or plates wanting; lateres with angular projections; altaceratubae prominent, five or six on each side, one in each second incisura; anus large, six times its width from caudal margin and over twice cephalad of vulva; brevaceratubae distinct, apparently third row with 4 oraceratubae, fourth row with 5 mesal and 2 lateral oraceratubae.—California on Cupressus.  
*cupressi* Colem.

SPECIES OF PSEUDODIASPIS

- a. Pygidium with two pairs of lobes; median pair of lobes broad, distal end squared, "resembling human incisor teeth," distinctly separated;

second pair of lobes hardly half length of first, much narrower; each lateris with angular prominence like third lobe, cephalad of this irregularly crenulate; setae large; plates cephalad of second and third lobes quite large, broad; scale of adult female convex, exuviae lateral, within margin, first exuvia at margin of second.—Mexico on Mimosa, ?Acacia. -----*dentilobia* Ckll.

3a. Pygidium with one pair of lobes.

- b. Pygidium with median pair of lobes broad, low, broader than long, close together, not adjacent, hardly projecting; plates wanting; lateres irregularly dentate, crenulate between dentations; apparently with three or four altaceratubae; scale of adult female flat, irregular, round to suboval, exuviae lateral to sublateral; scale of male mytiliform, exuvia at end.—Arizona on Larrea.-----*larreae* Ckll.

- bb. Pygidium with median pair of lobes large and prominent, not broader than long.

- c. Pygidium with anus located near vulva, five times its width from caudal margin and eighteen times its width caudad of vulva; median pair of lobes large, prominent, mesal margins parallel, near together, prominent lateral notch, distal end rounded; setae as long as lobes; plates short, dagger-shaped, arranged 0, 3, those of each lateris distant and located on caudal one-fourth of pygidium; altaceratubae apparently wanting; dorsal oraceratubae few in number, promiscuously arranged; mesal calles present and fused, lateral calles short and distant from mesal.—Apparently not congeneric.—California on Atriplex. -----*atriplexis* Ferris.

- cc. Pygidium with anus and vulva superimposed, about eleven times its width from caudal margin; median pair of lobes large, widely separated, prominent, broader than long, margins broadly rounded, crenulate; lateres broadly irregularly crenulate, caudal crenulation in position of second pair of lobes; plates wanting; altaceratubae apparently wanting; dorsal oraceratubae fairly numerous, small, irregularly arranged.—Apparently not congeneric.—California on Phoradendron.-----*multipora* Ferris.

SPECIES OF VERSICULASPIS

Pygidium with deep angular pygidial incision; median pair of lobes located in pygidial incision, not projecting beyond its margin, distant, suboblique, divergent, not confluent, margin serrate, subtruncate; second pair of lobes apparently incised, triangular, bluntly pointed; plates apparently wanting; altaceratubae small, slender, apparently numerous; brevaceratubae apparently few in number.—South Africa on Diosma. -----*diosmae* Brain.

SPECIES OF PROTODIASPIS

a. Pygidium with two pairs of lobes.

- b. Pygidium with four very low, broad, rounded, colorless lobes, distant, margins inclined to be crenulate; plates wanting; setae

very small; cuticle with numerous oraceratubae; mesogenacerores about 11; anus distinct, fair distance from caudal margin, cuticle around anus strongly concentrically striate.—Mexico on oak.-----

*parvula* Ckll.

- bb. Pygidium of adult female with four lobe-like projections; median pair of lobes near together, broader than long, broadly rounded, entire; second pair of lobes incised, mesal lobelet largest, margins rounded, entire; dorsal oraceratubae numerous, small, irregularly arranged; anus large, about fourteen times its width cephalad of caudal margin and about once cephalad of vulva; setae minute; pygidium of second nymphal female with four minute distant subequal lobes, distance between lobes about three times width of lobe; setae few and minute; anus prominent, about five times its width from caudal margin; plates wanting.—Arizona on Quercus. -----*pulchra* Ferris.
- aa. Pygidium without lobes or lobe-like projections.
  - b. Pygidium as broad as or broader than long, margin broadly rounded, not pointed.
    - c. Pygidium with margin coarsely irregularly crenulate, without lobes or plates; setae four in number, moderate in length; anus located distant from caudal margin, around anus a number of conspicuous thin spots in cuticle, appearing as perforations; pygidium of second nymphal female with three plates on each side; spiracerores wanting; surface of body finely carinate.—South Africa on Euclea.-----*imbricata* Brain.
    - cc. Pygidium with margin entire, smooth, broadly rounded, bearing four minute distant setae; anus small, about eighteen times its width from caudal margin and four times caudad of vulva.—Resembles species of *Gymnaspis* or *Aonidia*.—Arizona on Acacia. -----*cdentata* Ferris.
  - bb. Pygidium longer than broad, distal portion pointed, never broadly rounded; body of adult female more or less globose; pygidium flattened, cordate, acuminate; lobes and plates wanting; margin with two irregular teeth-like projections at caudal end; anus small, near cephalic end, twenty or more times its width from caudal margin; setae minute, one on each side near cephalic end of margin, few on disk; many linear thickenings radiating inwards from margin; pygidium of second nymphal female broad, rounded, hinged, semicircular plate; setae, lobes, plates, wanting; similar to preceding species.—Australia on Acacia.-----  
*anomala* Green.

SPECIES OF NUDACHASPIS

Insects forming galls upon leaves and stem of host-plant, external opening to gall typically closed by first exuvia, second exuvia thin, enclosing adult puparium-like in early adult, ruptured later and insect extruded; body of insect "comma-shaped," enlarged cephalic portion bent at right angles to caudal portion; pygidium of adult female without lobes, plates, or setae; with seven serrate lobe-like projections on each side, probably pseudolobes, projections disappear with age; altacera-

tubae and brevaceratubae wanting; mesospiracerores and metaspiracerores present; anus and vulva located near cephalic end of pygidium; pygidium of second nymphal female with pair of median lobes, projecting, lateral margins free, triangular in outline, confluent at proximal end, second and third pairs of lobes much smaller, distal margin notched at middle.—Ceylon on *Loranthus*.-----*fodiens* Green.

## SPECIES OF XANTHOPTALMA

Insects with body nearly circular, less than one-half millimeter in length; caudal end of abdomen minutely serrate with three pairs of serrate triangular lobe-like projections with setae at their distal ends, arranged like lobes; anus located over three times its width from caudal margin; female probably transforms in a puparium.—Mexico on "laurel tree."-----*concinnum* Kkll. & Parr.

## SPECIES OF CREDODIASPIS

Pygidium with adult female with median pair of lobes large, longer than broad, distal end bluntly rounded, sides parallel; other lobes obsolete; each lateris with three long dagger-shaped plates, largest adjacent to each third lobe, smallest near middle of each lateris, other plate nearly midway between cephalic and caudal plates, slightly nearer caudal; spiracerores and genacerores wanting; two minute latadentes bearing oraceratubae located between median pair of lobes and an oraceratuba on each side between two caudal plates; pygidium of second nymphal female with four pairs of lobes, median pair oblique, mesal margins with two or three indentations; second, third, and fourth pairs of lobes quadrangular, subequal, entire; plates arranged 0, 1, 1, 1, 5, cephalic plate of each lateris similar in form to those of incisurae, others broad, pointed, sides crenulate; oraceratubae located in second, third, fourth incisurae and between two caudal plates of each lateris.—South Africa on *Cynometra*.-----*limuloides* Lindgr.

## SPECIES OF ADISCODIASPIS

Pygidium of adult female without lobes, setae, plates, or genacerores; ceratubae short, numerous, arranged in a series or in a mass on the pygidium and on the border of the segments of preabdomen; scale rounded, ostreiform, white with yellow first exuvia, placed near periphery, ventral scale thick and flat.—France on *Erica*.-----

*ericicola* Marchal.

## CHAPTER XXVI

### TRIBE FIORINIINI

#### *The Uhlerian Scales*

The body of the adult female is always distinctly longer than broad with the cephalic end bluntly rounded and the caudal end bluntly pointed. The lateral margins are usually parallel or subparallel with the indentations marking the position of the sutures between the thoracic and abdominal segments generally more or less distinct. The lateral margins of the segments of the preabdomen are sometimes provided with bracteae in the adult female or second nymphal female. Lobes are usually present in the adult female, usually about two pairs, more or less than this number may be present. Plates although frequently present, may be absent; furcapectinae are never present. The incisurae are narrow and the spaces may be filled or not with plates. Densariae and paraphyses are never present. Altaceratubae are rarely absent and are not arranged in pairs, their oraceratubae are ovate in outline, always longer than broad. Brevaceratubae are rarely if ever present, never arranged in rows. Genacerores are frequently present, usually arranged in five or three groups. The mesogenacerores, when present, usually consist of about five cerores. The scale of the adult female is thin, brownish or yellowish in color. It is much longer than broad, two or more times, usually with the sides parallel, not enlarged at one end, never transversely ridged, sometimes with a mesal carina. The first exuvia projects beyond the cephalic end of the secretory portion and bears the perfect remains of the antennae. The wax is limited to the periphery and is small in amount. The female always transforms in a puparium and the pygidium of the adult female may be provided with pseudolobes. The scales are usually exposed upon the host-plant, but may be concealed in pits in the leaf or in galls. The scales produced in galls are frequently opaque white, consisting in great part of wax and the exuvia is one-fourth or less the length of the scale. The surface may be flat, slightly convex, or slightly carinate.

The first species of this tribe was described by Targioni Tozzetti in 1867 as *Diaspis fioriniae*. The following year he erected a new genus, *Fiorinia*, for this species and renamed the insect *Fiorinia pellucida*. This latter name was used by Signoret and by Comstock who described a second species, *Fiorinia camelliae*, which was a serious pest in the conservatories of the United States Department of Agriculture in Washington. In 1883 Comstock called attention to the fact that Targioni Tozzetti had no authority



for changing the name of his species and restored the original name of the insect, *Fiorinia fioriniae*. There was at this time a rule of the British Association code, which was generally followed in matters of nomenclature, prohibiting the use of the same word for both generic and specific names. Comstock consequently renamed the genus after one of the early American entomologists who had made a special study of the Hemiptera, Philip Uhler, designating the genus *Uhleria*. This rule regarding the use of the same word for both names of an animal was afterwards rescinded and the species of Targioni Tozzetti is now known as *Fiorinia fioriniae*. The *camelliae* of Comstock has also been shown to be the same as the *fioriniae* of Targioni Tozzetti. The selection of a vernacular name for the insects of this tribe has been a difficult one. It was finally decided to form a name out of the generic name of Comstock and call them The Uhlerian Scales.

Leonardi included the genus *Fiorinia* together with the genera *Mytilaspis* and *Ischnaspis* in the tribe *Mytilaspides* in his original subdivision of the subfamily *Diaspidinae* published in 1898. In the same volume, where there is given the first statement of his monograph of the *Mytilaspides*, he states that the following table, one to genera and subgenera, relates only to the genus *Mytilaspis*, because he combines *Ischnaspis* with this genus, rather than to the *Mytilaspides* and that the lacking genus *Fiorinia* will be considered a little later. The *Mytilaspides* was published in 1903 in which he states, to translate the thought rather than the words, the group *Mytilaspides* is conveniently distinguished as two sections, one formed from the species of the genus *Mytilaspis* and the other from the species of the genus *Fiorinia*. The essay on the classification of the *Fioriniini*, "*Generie e Specie di Diaspiti. Saggio di sistematica delle Fioriniae*" was published in 1906. In this revision four genera and twenty-two species are recognized, while ten unidentified species are referred to the tribe.

The scale of the adult female is elongate, two or more times as long as wide, and usually narrow. The two sides are usually parallel or subparallel, but in certain species the caudal end is widened so that the scale is distinctly pyriform. The scales are generally some shade of brown or yellow, but in some species are opaque white. The surface of the scale is generally flat or slightly convex externally, but may be slightly carinate. The exuvia of the first nymph is always placed at the cephalic end so that it projects beyond the scale for at least one-half the length of

the exuvia. This exuvia retains the antennae of this stage as minute rigid structures at its cephalic end. The caudal part of the first exuvia is placed over the cephalic part of the second, which in all species of this tribe serves as a puparium for enclosing the adult female. The skin of the second nymphal female is very large and in most species is almost as large as the entire scale. The wax is represented in addition to what covers the second exuvia by a narrow peripheral band and the puparium seems to constitute the entire scale. The puparium is fastened to the first exuvia and is covered by a thin sheet of wax to which it adheres. The wax of the scale is very thin, a transparent colorless layer, and the color of the adult scale is due to the color of the exuvia and not to the color of the secretory part of the scale as in most other Diaspidinae. The ventral scale like the dorsal scale is very thin and colorless. It forms a continuous sheet of wax completely closing the scale in some species and is interrupted on the meson or discontinuous in others.

The exuvia of the females of the second nymphal stage or the puparium is much larger than the body of the adult female which it encloses. The cuticle is tough and the pygidium and its caudal end is well developed. The body of the adult female occupies the caudal two-thirds or one-half of the puparium, but when the female begins to deposit eggs, which from the necessity of the case are placed in the caudal end of the puparium, her body is forced into the cephalic part of the puparium. The absence of genacerores in the species forming galls would suggest that they are probably ovoviviparous, but nothing is known as to their development.

The scale of the male is elongate, about three times as long as the broadest part. The sides are parallel or subparallel or sometimes they very gradually diverge caudad and near the caudal end after reaching their greatest divergence they converge suddenly and form a bluntly rounded caudal end, producing a scale similar in general form to those of many male Diaspidini. The dorsal surface of the scale may be flat or slightly convex externally, sometimes with a slight mesal carina or slightly tricarinate. The scale is frequently white or opaque white and the single exposed exuvia is yellowish. The males, as in the males of certain species of Diaspidini, are gregarious and several may be found collected together in a small area. They are sometimes more or less concealed by a filamentous or flocculent excretion of wax or the portion of the leaf to which they are attached may be coated with a mass of whitish powdery wax.

A few of the species live in depressions or pockets in the leaves of the host-plant or produce abnormal growths or galls upon their surface. In the case of *Adiscofiorinia secreta* described by Green, the enclosing gall is minute and conical. The puparium and the body of the adult female is peculiar in form, having the cephalic portion greatly swollen, so that it resembles the pupa of a syrphid-fly according to Green. The galls are confined to the upper surface of the leaf with an opening to the exterior extending into the gall from the under surface which is always closed by the first exuvia. The puparium rests in the gall in an erect position with its pygidium directed toward the opening and the first exuvia. "The male scales are sunk in shallow depressions on the under surface."

The species are found in great part, at least so far as described species are concerned, in Asia and Australia. Of the twenty-five species listed in Fernald's Catalogue, nine are reported from Australia, five from New Zealand, three from Mauritius, five from Ceylon, one from India, two from China, three from Japan, one from Kew Gardens, England on *Howea*, a palm from the Australian region, and one species of common occurrence on many species of plants grown under glass in Europe and America which is also found commonly in Brazil, Australia, Ceylon, and Japan upon plants in the open air. This species is probably also a native of the Indian or Australian region.

The body of the adult female is usually elongate. The segmentation of the thorax is usually obscure, but that of the preabdomen is frequently distinct. The cephalic end of the body is truncate or broadly rounded. The antennae are rudimentary and usually do not differ in form from those of other adult female Diaspidinae, except that they are frequently larger. They differ in certain species as to their location on the ventral aspect, being very distant in some and close together in others. The ventral surface of the head is sometimes elevated horn-like between them.

The pygidium is generally distinctly separated from the preabdomen, frequently somewhat five-sided. The mesal portion of the caudal end is more or less truncate and frequently also more or less hollowed out forming a pygidial incision. The lobes in the generalized species are represented by three pairs, but there is usually less than this number of pairs, frequently reduced to a single pair, and sometimes wanting. The lateres are without projections of any sort or with pseudolobes. The median pair of lobes is generally the largest, they are frequently oblique with

their margins more or less serrate. The second pair of lobes are small and are frequently deeply incised. The plates are usually small and inconspicuous and greatly reduced in number. The maximum number appears to be 2, 2, 3, 3, but the usual number is 0, 1, 1 or 2, 3 or none. Pectinae, even furcapectinae, are so far as known, always wanting. The plates of the median incisura are very variable in their presence or absence. The oraceratubae of the altaceratubae are usually placed singly, about four on each side of the meson or lateral half of the pygidium. They generally open in latadentes or lobe-like projections in the incisurae. The altaceratubae are comparatively long broad tubes in the generalized species, but Green in his figures of the pygidium of *saprosomae* and *similis* shows the altaceratubae as slender tubes like the clavaceratubae or lamaceratubae of other Diaspidinae. This observation is of interest as indicating the form of the primitive ceratubae and the way in which they are modified. The absence of plates and the proven accuracy of Green's work leaves slight chance for these to be lamaceratubae. The brevaceratubae are apparently always wanting.

The vulva is usually located near or slightly cephalad of the middle of the pygidium. The anus is located at nearly the same level as the vulva, usually less than its own width or diameter cephalad of the vulva. This is different from the condition found in most Mytilaspini where the anus is typically located near the cephalic end of the pygidium distant from the position or level of the vulva. Although the Fioriniini have been more generally associated with the Mytilaspini, this arrangement is much more like that of typical Diaspidini. Genacerores are present in all the genera but one which contains only six species. There are usually five groups, the mesogenacerores are only rarely wanting and the cerores of the mesogenacerores and pregenacerores or even of all five groups are sometimes contiguous so that the pygidium appears to bear a single inverted U-shaped group or omnogenaceroris.

The most comprehensive published account of the species of this tribe is that of Leonardi to which reference has already been made. The fact that the females of all the species become mature in a puparium, if judgment may be formed of the pygidial structures found in the females of other tribes with a similar development, leads to the conclusion that a perfect understanding of the pygidial structures of the adult female must be secured through a study of the pygidium of the second and first nymphal stages. Leonardi has unfortunately figured and described only the margin

of the pygidium of the adult female and even these figures are not every thing to be desired. The custom of Green, Newstead, and Lindinger of figuring the pygidial fringe of one or both of the nymphal stages is an excellent one and will need to be done for all of the species of this tribe before an accurate classification of the species can be made.

Leonardi recognized three new generic names: *Trulliflorinia*, for which *acaciae* Mask. may be taken as the type, *Anameflorinia*, for which *casuarinae* Mask. may be taken as type, and *Adiscoflorinia*, for which *secreta* Green may be taken as type. Lindinger in 1911 proposed the name *Cryptthemichionaspis*. While he does not describe this genus, he states *Anameflorinia* Leon. and *Trulliflorinia* Leon. are synonyms. There are three species included under the genus *Cryptthemichionaspis*, *acacia* Mask., which may be taken as the type, *lidgetti* Green, and *nigra* Lingr. The description of *alaeodendri* Charm. was not available and could not be placed. The following synopsis, based in the main upon that of Leonardi, will aid in the identification of the species:—

#### GENERA OF FIORINIINI

- a. Pygidium of adult female always with genacerores.
  - b. Pygidium of adult female with plates and usually with one to three pairs of lobes, rarely without lobes.-----*Fiorinia* Targ.
  - bb. Pygidium of adult female entirely without plates.
    - c. Pygidium of adult female with three or five groups of genacerores, if with three groups, mesogenacerores and pregenacerores confluent.
      - d. Pygidium of adult female with at least one pair of lobes; pygidial margin with projections. -----*Trulliflorinia* Leon.
      - dd. Pygidium of adult female without lobes; pygidial margin without projections, entire or serrate. ---*Anameflorinia* Leon.
    - cc. Pygidium of adult female with two groups of genacerores.—Type, *Fiorinia bambusae* Maskell.-----*Ischnaflorinia* MacG.
  - aa. Pygidium of adult female always without genacerores.
    - b. Pygidium of adult female with single median pair of lobes.—Type, *Fiorinia rubra* Mask. -----*Paraflorinia* MacG.
    - bb. Pygidium of adult female always without lobes. -----*Adiscoflorinia* Leon.

#### SPECIES OF FIORINIA

- a. Pygidium always with at least one pair of lobes.
  - b. Pygidium with median pair of lobes distinctly separated.
  - c. Pygidium with pair of plates between median pair of lobes.

- d. Pygidium narrow, caudal end convex, not hollowed out; median pair of lobes prominent, longer than broad, sides parallel, distal end bluntly rounded; plates long and slender, much longer than lobes, arranged 2, 2, those of each lateris adjacent to median lobe; lateres cephalad of cephalic plates finely serrate and without projections; setae minute, not one-half length of plates; genacerores 3-3(3-4)3-3; mesospiracerores obsolete.—Ceylon. -----*bidens* Green.
- dd. Pygidium comparatively broad, caudal end deeply hollowed out; median pair of lobes widely divergent, strongly oblique, located in concavity, mesal margins with four to six teeth, other lobes wanting; plates arranged 2, 4, those of median incisura short, much shorter than median lobes, those of each lateris arranged in two groups of two each, one group near median lobe; each lateris with angular projections; genacerores 5-6(10-10)10-13.—Philippine Islands on *Machilus*.-----*phantosura* Ckll. & Rob.
- cc. Pygidium without plates between the median pair of lobes.
  - d. Pygidium with five groups of genacerores combined into a single omnagenaceroris, total number of cerores 25-29; median pair of lobes small, short and narrow, deeply angularly notched at middle of distal margin; second pair of lobes minute, hardly produced; plates long, broad at base, much longer than the lobes, arranged 0, 1, 6 to 7, those of each lateris arranged 1-1-4 or 1-3-3; genacerores 5-5(7-10)10-14; spiracerores obsolete.—Ceylon on *Odina*.-----*odinac* Leon.
  - dd. Pygidium with genacerores combined into a single large omnaceroris, total number of cerores 86-91.—India on *Taxus*.  
*odinac multipora* Lindgr.
- bb. Pygidium with median pair of lobes fused at proximal end.
- c. Pygidium with three pairs of lobes.
  - d. Pygidium with each second lobe doubly incised, three lobelets subequal, entire, distal end bluntly rounded, median pair of lobes strongly oblique, inserted in deep concavity, mesal margin of each finely serrate; third pair of lobes about as large and similar in shape to lateral lobelet of second lobe; plates arranged 0, 1, 1, 0, long and slender, much longer than lobes; genacerores 7-7(13-14)17-17; mesospiracerores 2-3.—Ceylon on *Juniperus*. -----*juniperi* Leon.
  - dd. Pygidium with each second lobe not incised.
    - e. Pygidium with genacerores 10-11(22-28)16-27; median pair of lobes small, adjacent, margins strongly dentate; second pair of lobes elongate, sometimes spatulate, distal end truncate; third pair of lobes similar in length to the second pair, long and narrow, distal end rounded; plates arranged 0, 1, 1, 2, plates more than twice as long as the lobes, those of each lateris arranged, one short distance cephalad of third lobe and one at cephalic end; second and third incisurae with projections as large or larger than

- adjacent lobes, bearing oraceratubae; brevaceratubae in three continuous series; mesospiracerores arranged in compact group; antennae close together; anus located some distance cephalad of vulva.—Java on Piper.....  
*diaspiformis* Newst.
- ee. Pygidium with genacerores 4-4(4-6)5-7; median pair of lobes small; second and third pairs of lobes small; margin of pygidium serrate and bearing several plates arranged in pairs along serrate edge.—New Zealand on Ribes.....  
*grossulariae* Mask.
- cc. Pygidium with less than three pairs of lobes.
- d. Pygidium with two pairs of lobes.
- e. Pygidium with second pair of lobes deeply incised.
- f. Head with dorsal aspect with prominent proboscis-like projection which extends cephalad and has distal end slightly globularly enlarged; pygidium with median pair of lobes fused at proximal end, strongly oblique, placed in concavity, margins serrate; second pair of lobes incised, mound-like, inconspicuous, lobelets subequal and similar; plates arranged 0, 1, 3, those of each lateris arranged, one adjacent to third lobe and two near middle; genacerores 6-6(13-16)21-23; mesospiracerores 1.—Ceylon on Gelonium.....*proboscitaria* Green.
- ff. Head never with dorsal proboscis-like projection, antennae situated in median depression and adjacent.
- g. Pygidium with genacerores 5-7(11-12)12-17; median pair of lobes fused at proximal end, strongly oblique, placed in concavity, margins serrate; second pair of lobes incised, mesal lobelet longest and sometimes notched on mesal and lateral margins, lateral lobelet bluntly rounded, entire; plates arranged 0, 1, 3, those of each lateris arranged two, longest, near a second lobe, and one near cephalic end; mesogenacerores and pregenacerores confluent, forming a solagenaceroris; mesospiracerores 4-5.—*Florinia florinae* minor Mask. —America, Europe, Australia, Ceylon, China, etc. on Camellia, Citrus, Psidium, Areca, Cycas, Anthurium, Phytelphas, Kentia, Hedera, Leptospermum, Ficus, Livistona, Podocarpus, Cupressus, palms, tea, ferns, etc. ....*florinae* Targ.
- gg. Pygidium with genacerores 4-4(16-22)24-27.—Japan on Podocarpus, Pinus. ....*florinae japonica* Kwn.
- ee. Pygidium with second pair of lobes not incised, distal end bluntly rounded, faintly notched on lateral margin; median pair of lobes fused at proximal end, strongly oblique, placed in concavity, margins serrate; plates arranged 0, 1, 0, single plate of each second incisura much longer than lobes; genacerores 2-2(6-9)15-15; mesospiracerores obsolete. —Ceylon on Grevia. ....*tumida* Leon.

- dd. Pygidium with single pair of lobes.
  - e. Head with antennae located on ventral aspect near cephalic margin, adjacent, cuticle between antennae prolonged beyond margin of body as prominent projection with large globular end; pygidium with median pair of lobes fused at proximal end, oblique, placed in concavity, distal portions serrate; second pair of lobes represented by slight incised serrate thickening of margin; plates arranged 0, 2, those of each lateris placed one cephalad of serrate thickening representing a second lobe and the other caudad of it; genacerores 4-5 (10-13) 15-18; mesospiracerores 2-3.—India on tea plant. -----*theae* Green.
  - ee. Head with cuticle between articulations of antennae not prolonged into prominent projection with globular end; pygidium with median pair of lobes not fused at proximal end, not oblique, placed in slight concavity, sides parallel, slightly longer than wide, distal end bluntly rounded, entire; plates arranged 0, 2; oraceratubae of each second incisura located in latadentes, cephalad of which is located two plates of each lateris; lateres indented and crenulate; genacerores 3-3 (4-5) 8-9; mesospiracerores 4.—New Caledonia on Baekia. -----*neo-caledonia* Ldgr.
- aa. Pygidium without lobes.
  - b. Pygidium with genacerores 0-3 (14-18) 12-16; pygidial margin semi-circular, broken by many irregularities, regular or conspicuous lobes wanting; margin with fourteen to eighteen setae on each side, about one-half of them short and fine, remainder long and strong; scale of adult female with rather strong transverse striae.—Japan on Bambusa. -----*signata* Mask.
  - bb. Pygidium with genacerores 5-8 (5-8) 5-8; pygidial margin semi-circular, regular lobes wanting, bearing numerous rather long and thick spine-like projections, eight to ten pairs, giving pygidial margin deeply serrated appearance; dorsal surface with brevaceratubae; scale of adult female not with transverse striae.—Considered as possible species of *Leucaspis* by Leonardi.—Japan on Bambusa. -----*tenuis* Mask.

SPECIES OF TRULLIFIORINIA

- a. Pygidium with the mesal portion of caudal margin not deeply incised with median pair of lobes situated in incision.
- b. Pygidium with margin, at least adjacent to median pair of lobes, with two or more tooth-like projections.
- c. Pygidium with genacerores arranged in five distinct groups.
  - d. Pygidium with genacerores arranged 3-6 (6-8) 6-8; mesospiracerores wanting; median pair of lobes short, bluntly rounded at distal end, contiguous at proximal end, sometimes faintly notched, mesal margins divergent, mesal margins sometimes adjacent and two lobes forming single hemispherical area, other individuals intermediate between these two types; plates wanting; each lateris with about three indentations



- with tooth-like projections between them; anus and vulva located at about same distance from caudal margin.—*Florinia acaciae* bilobis Full.—Australia on *Acacia*.-----*acaciae* Mask.
- dd. Pygidium with genacerores arranged 3-3(6-6)5-6; mesospiracerores 0-2; median pair of lobes adjacent, entire, bluntly pointed, hardly projecting beyond general contour of caudal margin; plates wanting; pygidium cephalad of each median lobe with three latadentes, bearing large oraceratubae, outlets of large altaceratubae; setae large and prominent; pygidium of second nymphal female with median lobes large, mesal margins straight, adjacent, prominent lateral notch; second pair of lobes large, deeply incised, mesal lobelet much larger than lateral; third pair of lobes deeply incised, lobelets short and broad; each second and third incisura with long triangular plate and prominent latadentis and plate on each lateris near third lobe.—*Crypthemichionaspis nigra* Lindgr.—South Australia on *Acacia*, *Phyllodian*. *nigra* Lindgr.
- cc. Pygidium with five groups of genacerores, mesogenacerores and pregenacerores confluent or almost so, forming solagenaceroris of 40 to 50 cerores, postgenacerores consisting of 15-20 cerores; median pair of lobes short, broad, broadly rounded, distant, with minute tooth-like projection between them; each lateris with lobe-like projections; plates apparently wanting; anus located in line with cephalic portions of postgenaceroris.—New Zealand on *Brachyglottis*.-----*minima* Mask.
- bb. Pygidium with margin adjacent to median pair of lobes finely serrate, not with tooth-like projections; median pair of lobes narrow, much longer than wide, oblique, distal end obliquely truncated;—Leonardi figures them as triangular, serrate, and contiguous at proximal end;—plates wanting; altaceratubae long and slender, linaceratuba-like; each lateris with indentations; vulva on line drawn between pregenacerores and postgenacerores, anus little farther cephalad; articulations of antennae distant; genacerores 3-5(13-18)13-18; mesospiracerores obsolete; margin of body with blunt marginal tubercles.—Ceylon.-----*similis* Green.
- aa. Pygidium with mesal part of caudal margin deeply incised, median pair of lobes situated in incision.
- b. Pygidium as broad as long, never twice as long as wide.
- c. Head with antennae articulated close together and with short cuticular projection bearing number of small spine-like points between them.
- d. Pygidium with median pair of lobes strongly oblique, proximal ends fused, mesal margins finely serrate on distal portion; plates wanting; altaceratubae long and slender, linaceratubae-like; each lateris with tooth-like projections adjacent to median pair of lobes and undulate cephalad of them; anus on line drawn between pregenacerores and postgenacerores, vulva slightly farther cephalad; genacerores 8-8(15-29)14-19; mesospiracerores 3; margin of body with blunt marginal tubercles.—Ceylon on *Saprosma*.--*saprosmae* Green.

- dd. Pygidium with median pair of lobes more prominent and distinctly serrate; second pair of lobes sometimes present.—Ceylon on *Gelonium*. -----*saprosmae gelonii* Green.
- cc. Head with articulations of antennae distant, never with circular projection between articulations.
  - d. Pygidium with vulva situated between pregenacerores, anus situated on line with mesogenacerores; median pair of lobes strongly oblique, fused at proximal ends, mesal margins serrate, caudal ends pointed; plates wanting; each lateris with rounded projections adjacent to median lobes, one or two indentations cephalad of them, margin serrate; genacerores 4-4(9-12)12-12; mesogenacerores 2.—Ceylon on *Murraya*. -----*rubrolincata* Leon.
  - dd. Pygidium with vulva situated between cephalic part of postgenacerores and anus on line drawn through mesogenacerores; median pair of lobes small, hardly projecting, strongly oblique, not adjacent at proximal end, mesal margins entire, caudal ends rounded; plates wanting; each lateris with two or three pointed projections adjacent to each median lobe and three equidistant indentations cephalad of them, margin entire; genacerores 4-6(7-11)7-13; mesogenacerores apparently wanting; living in glandular pockets in angles of veins of under surface of leaves; scale of male longer than that of female.—Ceylon on *Gaertnera*. -----*scrobicularum* Green.
- bb. Pygidium greatly elongated, lateral margins long, slightly convergent, subparallel, length over three times width of narrowest part; median pair of lobes small, inconspicuous, oblique, finely serrate; plates wanting, each lateris long, without projections or indentations, undulate; two setae between median lobes, two adjacent to lateral margin of each median lobe, and three subequidistant groups of 2-2-1, one dorsal and one ventral, cephalad of this later group; genacerores present, number of mesogenacerores and pregenacerores unknown and of postgenacerores 8-9; mesospiracerores obsolete.—Java on *Rhaphis*. -----*macroprocta* Leon.

SPECIES OF ANAMEFLORINIA

- a. Thorax with mesospiracerores present.
  - b. Thorax with mesospiracerores 18-20; pygidium without lobes, plates, or pseudolobes, margin crenulate, apparently without setae; anus located between pregenacerores; caudal portion of pygidium with two transverse rows of irregular chitinated areas, four areas in a row; genacerores 15-15(23-34)23-26.—Green shows 3-3(17-18) 8-9;—pygidium of second nymphal female with four pairs of lobe-like projections, caudal pair largest, others successively smaller, triangular, notched; indentations between lobes each with a single short blunt projection, not extending beyond indentation.—*Florinia maskelli* Brittin.—New Zealand on *Plagianthus*, *Veronica*, *Pittosporum*. -----*maskelli* Brittin.
  - bb. Thorax with mesospiracerores 4-5; pygidium without lobes, plates, pectinae, or pseudolobes, margin entire, only slightly undulate,

- several setae, some distance from margin; pygidium broad, broadly rounded; anus located much farther caudad than vulva; genacerores 10-10(6-9)6-7.—Australia on *Casuarina*.—*casuarinae* Mask.
- aa. Thorax with mesopsiracerores wanting; pygidium without lobes, plates, pectinae, or pseudolobes, margin slightly undulate and finely serrate; dorsal and ventral row of marginal setae; pygidium with sides converging rapidly caudad, subtriangular, not broad, broadly rounded; anus located cephalad of vulva in line with mesogenacerores and vulva in line with postgenacerores; genacerores 2-2(5-5)4-4.—Australia on *Acacia*.—*lidgetti* Green.

## SPECIES OF ISCHNAFIORINIA

Scale of adult female elongate, twenty-five or more times as long as wide, excessively slender, sides straight and parallel, wax thin and transparent, color white, appears yellow from puparium showing through; body elongate, several times longer than broad; pygidium with two median trifoliate lobes, sometimes apparently wanting, figured as slender knobbed spatulate structures; pygidial margin finely serrate with few "spiny hairs" between and near median lobes; genacerores arranged in two groups of three cerores each.—China on *Bambusa*.—*bambusac* Mask.

## SPECIES OF PARAFIORINIA

- a. Insect living free, not producing galls.
- b. Pygidium with median pair of lobes adjacent, short, broad, broader than long, mesal angle prominent, lateral margin broadly roundly oblique, minutely serrate; caudal end of pygidium not hollowed out, lobe-like angular projection at lateral margin of each lobe; each lateris serrate with about nine "spines" on each side; brevaceratubae apparently present.—*Fiorinia rubra* propinqua Mask.—Australia on *Acacia*.—*rubra* Mask.
- bb. Pygidium with median pair of lobes adjacent only at proximal end, strongly oblique, placed in a deep pygidial incision, distal ends bluntly pointed, mesal margin finely serrate; each lateris distinctly dentate, with few short thick "spines."—China, Formosa, Queensland on *Nephelium*.—*nephelii* Mask.
- aa. Insects producing galls, arranged in series around margin of leaf; pygidium of adult female with median pair of lobes projecting, exceeding in length adjacent setae; other lobes wanting; dorsal and ventral oraceratubae wanting.—Algeria on *Nephelium*.—*hirsuta* Marchal.

## SPECIES OF ADISCOFIORINIA

- a. Pygidium with irregular arched group of "circumgenital glands" on ventral aspect at cephalic end adjacent to preabdomen; margin semi-circular, without projections or indentations, with few short setae just within margin; anus central in position; pygidium of second nymphal female with distinct quadrangular lobes, longer than wide, deeply notched for at least one-half their length, with four angular adjacent lobe-like projections cephalad of each median lobe.—Egypt on Poplar. —*africana* Newst.

- aa. Pygidium not with transverse band of oraceratubae or cerores at cephalic end of ventral aspect adjacent to preabdomen.
- b. Pygidium short and broad, never twice as long as wide.
  - c. Pygidium with caudal margin not truncate and lateral margins straight.
    - d. Pygidium with anus located little cephalad of vulva; spiracles with spiracerores; pygidium with sides converging caudad and caudal end transverse and indented to form four rounded lobules; pygidial margin with band of seven or eight setae.—Ceylon on *Atalantia*. ----- *atalantiac* Leon.
    - dd. Pygidium with anus located near middle of its length and vulva little farther caudad; spiracles encircled by minute spiracerores; pygidium with sides converging or broadly rounded, distinctly broader than long, margin with about eight long slender setae arranged in three groups, group of three on middle of each side and group of two at caudal end, latter longer than others, and two rows on disk of pygidium, row of six on line drawn through anus and row of two on line between anus and margin.—England, Kew Gardens on *Howea*. ----- *kewensis* Newst.
  - cc. Pygidium with caudal margin truncate and each side straight and not converging caudad, caudal margin coarsely crenulate; cephalic end of body narrow, cylindrical, and truncate; margin of pygidium with minute median depression on each side with two or three short setae.—*Fiorinia expansa* Mask.—Australia on *Melaleuca*. ----- *expansa* Mask.
- bb. Pygidium twice as long as broad, meson of caudal end with asymmetrical lobe-like projection, sides with asymmetrical pseudolobes, surface longitudinally striate; vulva located near cephalic end of pygidium and anus located near caudal end; spiracles elevated on small round tubercles; insects living in galls formed upon upper surface of leaf, body swollen, pupa-like.—Ceylon on *Grewia*. ----- *secreta* Green.

## CHAPTER XXVII

### TRIBE ASPIDIOTINI

#### *The Deltoid Scales*

The body of the adult female is broader than long, rarely slightly longer than broad. The cephalic end is usually broadest, broadly rounded, and the two lateral margins converge caudad to a bluntly rounded point. The body has a distinct triangular or deltoid outline. The indentations in the lateral margin of the thorax and preabdomen marking the position of the coriae may be distinct, but are frequently obscure. The segmentation of the preabdomen is always more distinct than that of the other parts of the body. The lateral margins of the segments of the preabdomen are never provided with bractae in either the adult or second nymphal female. Lobes are usually present in the adult female, typically three pairs, although more or less than this number may be present, or they may be absent, or absent and represented by pseudolobes. Pectinae and plates are usually present, pectinae may be of any type, only rarely distapectinae. The incisurae are usually narrow and filled with pectinae or plates, sometimes small. Densariae and paraphyses are frequently present. Altaceratubae are never present or at least very rarely. Brevaceratubae at most only rarely present, are never arranged in crescentic transverse rows, and are replaced by clavaceratubae and linaceratubae. Genacerores are frequently present, arranged in five, four, or two groups. The mesogenacerores, when present, usually consist of only a few pores, about six or less, frequently wanting. Scale of the adult female coriaceous or thin and usually brownish, reddish, blackish, or grayish in color, rarely white. Typical in form, round with the exuviae at the center, one exuvia superimposed over the middle of the other, scale rarely oval in outline with the exuviae slightly eccentric, but never at or projecting beyond the margin, never pyriform or mussel-shaped, rarely two or three times as long as broad with subparallel sides. The female sometimes transforms in a puparium so that the scale of the adult female may contain only the first exuvia and the pygidium is usually provided with pseudolobes. The scale of the male is similar in shape and color to that of the female but differs in having a single exuvia. It is never provided with a mesal carina and is rarely chalky white in color.

A considerable number of the injurious species of the Diaspidinae belong to the tribe Aspidiotini. In fact not only some of the most injurious but some of the best known species of coccids,

as the San José Scale, belong to this tribe. The general form of the scale and of the body makes it an easily identified group and, since there is but slight variation in their general structure, there is but slight reason for misplacing the species of this tribe in any systematic scheme. The species show a wide range of variation in many of the characters peculiar to them. This is particularly true when they are compared as to the serial modification of their lobes, pectinae, plates, genacerores, transformation in a puparium, and the development of pseudolobes. Because of this range of variation, the tribe includes several very generalized species and a number of greatly modified and highly specialized species representing a number of distinct lines of development.

The scale of the adult female is quite constant in form. It is circular in outline and usually varies from this shape only in those individuals that occur on narrow leaved plants or where the space for development of the scale is limited either through the crowding together of the insects upon the plant or the form of the plant. In a few other species, apparently without cause, certain individuals also depart from the typical circular form of the scale. The scales of such individuals are usually short oval in outline, very rarely twice as long as wide. They are readily differentiated from the round or oval scales of other tribes in that the two ends of the scale, if oval, are similar and broadly rounded, while the two exuviae are always placed near the center of the scale, very rarely if ever adjacent to the periphery of the scale and never projecting over the margin. They differ also in that the first exuvia is borne superimposed over the middle of the second and not at one end as in the scales of the other tribes. In individuals of this tribe the nymphs of the first stage when ready to cast their cuticle or molt, rupture it around the periphery of the entire body and the antennae remain attached to the ventral portion of the exuvia and not to the dorsal portion as in the scales of the previously described tribes. The wax of the scales is generally of considerable extent and while ordinarily dark in color, brownish, reddish, or blackish, they are often grayish, and only rarely are whitish or white. The waxy covering may be either thick and opaque or thin and transparent. The first exuvia is usually covered by a very thin covering of wax and in many species frequently bears a minute central nipple-like prominence of wax, the cicatrix, which is the remains of the first downy ball of wax formed by the nymph of the first stage. The cicatrix is white in color and when placed upon a dark colored exuvia is very conspicuous. The exuviae are generally

light yellowish in color, but may be blackish or brownish. The ventral scale varies greatly in consistency from a delicate tissue-like sheet to a rather thick pellicle. It usually remains attached to the host-plant and is in most cases so delicate that the ventral portion of the exuvia is generally lost. The scales are more or less convex or obconical, the exuviae and cicatrix being placed on the highest part of the scale. This arrangement gives the scales quite an armored shield-like appearance from which has been derived many of their scientific names as well as the common name of the Armored Scales, applied to the subfamily as a whole. This structure is typical, however, only of the scales of the tribe Aspidiotini.

The scale of the male is similar in shape, appearance, and color to that of the female. They differ from the scales of the adult female only in having a single exuvia and their much smaller size. The scale of the male is so similar to that of the first stage female that it is generally quite difficult to differentiate them and frequently this can only be done by examining the insects under the scales. The scales of those males having females with oval scales are frequently also oval.

The body of the adult female is located under the central part of the scale. It is typically triangular or deltoid in shape, broadest across the thorax or head, the exact location varying with the species. When widest across the head, the cephalic end of the body is frequently very broad and sometimes truncate. The body, even when fully expanded, is rarely twice and in most species is about one and one-half times as long as wide, but, when the segments of the preabdomen and pygidium are retracted or telescoped as is the usual condition in the dead and dried individuals, the body is not any longer than wide and is frequently even wider than long. In those species that lay eggs the retraction of the caudal end of the body makes a place for the eggs which are usually mixed with the fine pulverulent wax excreted by the genacerores. The antennae are typical of the form found in the subfamily. Each consists of a small tubercle bearing a long curved seta surrounded by one or more much shorter ones, usually about four. The antennae are often greatly reduced in size or wanting. The segmentation of the thorax is generally obscure. There are a few genera as *Selenaspidus* and its near allies in which there is a deep constriction between the mesothorax and metathorax. In fully expanded individuals the segmentation of the preabdomen is fairly distinct and the lateral indentations are rather prominent. The

segments are for the most part crescentic in outline which permits of their being telescoped together and the pygidium drawn into the cavity formed at their caudal end. Their lateral margins are not or only rarely prolonged and do not bear lateral groups of bracteae or plates as is so characteristic of many mytilaspids, diaspidids, and parlatorids.

The preabdomen and pygidium are usually distinctly separated. The pygidium is generally provided with a pygidial fringe that is typical in form and arrangement. The triangular shape of the pygidium is also characteristic. The maximum number of pairs of lobes appears to be four, there are frequently only two or three and in a number of species there is only a single pair. Those species transforming in a puparium, as *Aonidia*, not only lack lobes, but are generally provided with pseudolobes. A few species not transforming in this way also lack all indication of a pygidial fringe and have the pygidial margin entire. When more than one pair of lobes is present, the lobes located cephalad of the median pair are usually much smaller than the median pair. These cephalic lobes vary greatly in shape and size and often resemble the latadentes found in other tribes. The caudal margin of the pygidium is only rarely concave or provided with a pygidial incision with the median pair of lobes located in the incision. The lobes are either notched or entire, rarely crenulate or serrate. The second pair of lobes and those cephalad of them are only rarely incised to form two or more lobelets of each lobe. The median lobes are usually much closer together than in *Lepidosaphes* or *Chionaspis*, frequently subadjacent, the median incisura is very narrow, but only rarely are the lobes fused to form a single mesal lobe.

The margin of the pygidium typically bears pectinae and plates or both. The pectinae vary greatly in the number and arrangement of their teeth or pectinations. The simplest type, the distapectinae, are sometimes found cephalad of the median pair of lobes, but probably more often between this pair of lobes where with specialization they become reduced to bifurcate furcapectinae. The number of species provided with latapectinae is not great, while there are many provided with unapectinae. The pectinations are usually situated on the side away from the median pair of lobes and are sometimes long and slender, at other times are longer than the central axis of the pectina in the unapectinae. These pectinae are of common occurrence in the incisurae cephalad of the median pair of lobes and upon the lateres. Furcapectinae



are of common occurrence in a number of species but only rarely do they have more than two projections or pectinations and these are usually distal. Some species, however, show an intergrading between the reduced unapectinae and the furcapectinae. A single individual may show bifurcate furcapectinae in the median incisura, furcapectinae with three or four distal projections in the second incisura, furcapectinae with three or four distal projections or those with five or six distal projections in third incisura, unapectinae in the fourth incisura, and broad mutipectinate unapectinae upon each lateris. The plates are usually long and slender. The occurrence of plates and furcapectinae upon the same individual is not unusual, the plates being confined to the median or the median and second incisurae while the second and cephalic incisurae may contain comparatively simple unapectinae as well as furcapectinae. The simpler forms of pectinae, those with a small number of pectinations, are found upon the caudal portion of the pygidium and those with a considerable number on the cephalic portion. The pygidial fringe in certain species is so reduced that not only lobes but pectinae and plates are also wanting. The pectinae and plates may both be wanting even when the lobes are present. The plates of the median incisura are often greatly reduced in diameter and length so that it is sometimes difficult to differentiate them from the setae, which seem in such cases to be larger, but only rarely are the plates or pectinae wanting. The plates and pectinae are quite typical in their arrangement, usually as follows, 2, 2, 3 or 2, 3 or 2, 0 to several. The greatest variation is found upon the lateres which lack them, bear only a few, or bear one or more groups consisting of several.

A characteristic feature of each lateris in the pygidia of many lepidosaphids and diaspidids is the presence of distinct indentations which are usually limited by more or less prominent projections, latadentes. These indentations are believed to mark upon the margin of the pygidium the divisions between the segments. There are usually one or two plates located on all or several of these areas of the lateres in these tribes. In the aspidiotids not only the indentations and projections are wanting but there is no indication of a segmental arrangement of the pectinae or plates when they occur upon the lateres. It may be found, when they are more carefully studied, that the location of the dorsal and ventral setae, which are associated with the dorsal and ventral surfaces of the lobes and latadentes in the other tribes, although not always located upon their respective lobes, will indicate some-

thing as to the segmentation of the pygidium of the aspidiotids. The lateres may be entire, serrate, or crenulate, but all deep indentations seem to be secondary in origin.

The ceratubae in the Aspidiotini are very different and characteristic in form and generally much more numerous in number than in the other tribes. One of the most striking features is the absence of altaceratubae, which are so characteristic of the species of the other groups. There may be oraceratubae located along the pygidial margin but their ceratubae are not of the altaceratuba type. Another striking feature is the absence of brevaceratubae. The records are such that a definite statement can not be made, but the presence of typical brevaceratubae in any aspidiotid is very doubtful. The plates and pectinae are provided with lamaceratubae as in the other tribes, but they are often very long, sometimes two or three times as long as the pectina or plate which they penetrate. The linaceratubae and clavaceratubae are found in most species although there is considerable variation in number. They are frequently fifteen to twenty times as long as wide, often as long as the entire pygidium. Where they occur in considerable numbers, their oraceratubae are often arranged in characteristic longitudinal rows. The oraceratubae are usually placed in the bottom of more or less distinct longitudinal furrows which usually extend from or near the margin of the pygidium obliquely or longitudinally across the pygidium.

The vulva is usually located near the middle of the pygidium, on a line drawn between the pregenacerores and postgenacerores, but may be situated some distance cephalad of this point, on a line drawn through the cephalic part of the pregenacerores. Where the genacerores are wanting, it can generally be identified near the middle of the pygidium by the radiating ridges of the cuticle which extend from its opening.

The anus is extremely variable in position. It is generally located about half way between the middle of the pygidium and its caudal end, but is commonly situated some distance caudad of the vulva and is only rarely if ever superimposed over the vulva or located cephalad of it.

Genacerores are frequently present, while the typical number of groups, five, is often present, there is more frequently four than five groups present. The number of groups in a few species is reduced to two. These are apparently formed by the fusion of the pregenacerores and postgenacerores of the same side. The only apparent explanation of the condition found in *Selenaspidus*,

where only two groups are found, is that all the mesogenacerores have been lost and that there has been a later reduction in the number of cerores in each lateral group. This must not be taken to imply that this is considered as the usual line of reduction followed where the genacerores have been lost. Where there is only a single group of genacerores on each side of the vulva, each group may be known as a latagenaceroris. The five groups are never fused to form a single, large, inverted, U-shaped mass of pores and only rarely are there more than five groups present. The number of cerores in each group of genacerores is generally not large, the mesogenacerores varying from one to eight, the pregenacerores from one to forty-two, and the postgenacerores from two to thirty. The most usual number is about two to five mesogenacerores and less than twelve pregenacerores and postgenacerores.

The dorsal surface of the cephalic portion of the pygidium is sometimes provided with a series of interlacing thickened lines forming the so-called lattice-shaped thickenings. While the caudal portion of the pygidium on the ventral aspect may be provided with densariae or the dorsal aspect with a few or numerous parapophyses which may be comparatively short or long and slender, the cephalic portion of the dorsal aspect is at times provided with distinct calli or other thickenings.

Cockerell and Leonardi have proposed and recognized several of the dichotomous subdivisions of the genus *Aspidiotus* as genera or as subgenera. On the following pages wherever possible, these groups and names have been recognized as of the rank of genera. The unnamed portions of these dichotomies have been recognized as of equivalent rank and named.

The following species have all been referred to the genus *Aspidiotus*, but this generic name has been omitted in each species, and, for various reasons, mostly because of the pooriness of the description, others because the description was not obtainable, have been omitted from the tables:—*alaeodendri* Charm., *Fiorinia* (Aonidia), from Mauritius; *alatus* Frogg. from New South Wales on *Eucalyptus*; *allaudi* Charm., (?Aonidia), from Mauritius; *allaudi galliformens* Charm., (Aonidia), from Mauritius; *bilobis* Mask. from China on grass; *bossieae* Mask. from Australia on *Bossia*; *caldesii* Targ. from Italy, west Australia on *Daphne*, *Acacia*; *coralinus* Frogg., (*Targionia*), from New South Wales on *Eremophila*; *chamaeropsis* Sign. from France on *Chamaerops*; *confusus* Frogg. from New South Wales on *Eucalyptus*; *dysoxyl* Mask. from New Zealand on *Dysoxylum*; *eglandulosus* Lindgr. from Guatemala, Panama on *Cereus*; *gidgei* Frogg. from New South Wales on *Acacia*; *junctilobius* Frogg. from New South Wales on *Exocarpus*; *kennedyae* Bdv. from Australia on *Kennedy*; *metrosideri* Mask., *Mytilaspis* (*Anoplaspis*), type of

Anoplaspis, from New Zealand on *Metrosideros*; myopori Lidd. from Australia on *Myoporum*; osmanthi Vall. from France on *Olea*; pandani Bdv. from India on *Pandanus*; phormii Sign. from France, Switzerland on *Phormium*; rubribullata Frogg., (*Aspidiella*), from west Australia, New South Wales on *Eucalyptus*; santali Mask., (*Diaspis*), from New Zealand on *Santalum*, pear, plum, other fruits; serrata Frogg. from New South Wales on *Acacia*; and sophorae Mask. from New Zealand on *Sophora*. The various groups recognized as genera can be separated by means of the following table:—

GENERA OF ASPIDIOTINI

- a. Body of adult female never enclosed in puparium; pygidium of adult female usually with lobes and pectinae or plates, never with pseudo-lobes, never with asymmetrically arranged projections.
- b. Mesothorax and metathorax never separated by deep transverse constriction.
- c. Pygidium of adult female always with genacerores.
- d. Pygidium of adult female always with pectinae or plates or with both, sometimes few in number and small.
- e. Pygidium always without densariae or paraphyses.
  - f. Pygidium of adult female always with four or five groups of genacerores.
    - g. Pygidium with four pairs of distinct lobes.—Type, *Aspidiotus subrubescens* Mask.—*Octaspidiotus* MacG.
    - gg. Pygidium with less than four pairs of lobes.
  - h. Pygidium always with three pairs of lobes.
    - i. Pygidium with mesal portion of caudal margin convex, never with deep square pygidial incision.—*Evaspidiotus* Leon.—*Aspidiotus* Bouche.
    - ii. Pygidium with mesal portion of caudal margin with deep square pygidial incision with median pair of lobes located in incision.—Type, *Aspidiotus excisus* Green.—*Tcmnaspidiotus* MacG.
  - hh. Pygidium with less than three pairs of lobes.
    - i. Pygidium with two pairs of distinct lobes.—*Aspidiella* Leon.
    - ii. Pygidium with single pair of lobes; second and third pairs replaced by short, colorless, plate-like, one or two-toothed projections.—Type, *Aspidiotus corticis-pini* Lindgr.—*Unaspidiotus* MacG.
- ff. Pygidium with two groups of genacerores.
  - g. Pygidium with three pairs of lobes.—Type, *Aspidiotus corokiae* Mask.—*Aspidioides* MacG.
  - gg. Pygidium with one pair of lobes.—Type, *Aspidiotus implicatus* Mask.—*Marlattaspis* MacG.
- ee. Pygidium always with densariae or paraphyses.

- f. *Pygidium* always with densariae.
- g. *Pygidium* of adult female with three pairs of lobes.  
*Furcaspis* Lindgr.
- gg. *Pygidium* of adult female with less than three pairs of lobes.
- h. *Pygidium* with two pairs of lobes.—Type, *Aspidiotus ostreaeformis* Curtis.—*Quadraspidotus* MacG.
- hh. *Pygidium* with single pair of lobes.—*Diaspidiotus* Leon.
- ff. *Pygidium* always with paraphyses.
- g. *Pygidium* always with four or five groups of genacerores.
- h. Scale of adult female circular or nearly so, exuviae superimposed one above the other, situated at or near middle of scale; pygidium with anus frequently nearer caudal margin than postgenacerores.  
*Chrysomphalus* Ashm.
- hh. Scale of adult female elongate and narrow, two or three times as long as broad, sides parallel or subparallel, exuviae superimposed one above the other and situated at or near one end of scale; pygidium with anus located between postgenacerores.—*Pseudischnaspis* Hemp.
- gg. *Pygidium* never with more than two groups of genacerores, one on each side of vulva.—Type, *Melanaspis samoana* Lindgr. ————*Lindingaspis* MacG.
- dd. *Pygidium* of adult female without pectinae or plates.
- e. *Pygidium* always without paraphyses.
- f. *Pygidium* with four to six groups of genacerores.
- g. *Pygidium* always with densariae; genacerores in four or five groups.
- h. *Pygidium* with two pairs of lobes.—Type, *Aspidiotus forbesi* Johns.————*Forbesaspis* MacG.
- hh. *Pygidium* with single pair of lobes.—Type, *Aspidiotus covilleae* Ferris.————*Ferrisaspis* MacG.
- gg. *Pygidium* never with densariae; genacerores in five or six groups; projections and mesal indentation present, lobes lacking. ————*Comstockiella* Ckll.
- ff. *Pygidium* with three groups of genacerores or with three groups fused into single inverted U-shaped group.—Type, *Odonaspis janeirensis* Hemp.—*Ligulaspis* MacG.
- ee. *Pygidium* always with distinct paraphyses.
- f. *Pygidium* with two large distinct groups of genacerores; lateres with lobe-like prolongations, caudal end rounded, two pairs of indentations continued as paraphyses; anus about midway between vulva and caudal margin.—*Odonaspis* Leon.

- ff. Pygidium with three groups of genacerores and two pairs of paraphyses; anus located near vulva.—Type, *Odonaspis bambusarum* Ckll. .... *Berlesaspidotus* MacG.
- cc. Pygidium of adult female never with genacerores.
- d. Pygidium of adult female always with pectinae or plates or both.
- e. Pygidium always without densariae or paraphyses.
- f. Pygidium with distinct median incisura, median pair of lobes never fused into single lobe.
- g. Pygidium with anus located near proximal end of median pair of lobes, distinctly nearer than midway between vulva and median pair of lobes.
- h. Body never with pair of large prominent, oval, gland-like areas on dorsal aspect near cephalic end.
- i. Pygidium with at least three pairs of lobes, second and third pairs rudimentary, median pair not convergent at distal end.
- j. Pygidium with normal pointed plates or pectinae.—Type, *Aspidiotus yuccae* Ckll. ....  
*Neosignoretia* MacG.
- jj. Pygidium with cylindrical plates with subparallel sides and truncate ends.—Type, *Aspidiotus mauritanicus* Newst. ....  
*Tollaspidotus* MacG.
- ii. Pygidium always with less than three pairs of lobes.
- j. Pygidium with two pairs of lobes, mesal margins of median pair distant and not convergent. .... *Cryptaspidotus* Lindgr.
- jj. Pygidium with single pair of lobes, mesal margins of median pair strongly convergent or lobes contiguous. .... *Morganella* Ckll.
- hh. Body always with pair of large, prominent, oval, gland-like areas on dorsal aspect near cephalic end. .... *Pseudotargonia* Lindgr.
- gg. Pygidium with anus located distant from proximal ends of median pair of lobes, about midway between vulva and median pair of lobes or nearer to vulva than to lobes.
- h. Pygidium with three or four pairs of lobes.
- i. Pygidium with four pairs of lobes.
- j. Plates, at least in part, twice as long as median pair of lobes, those of median and second incisurae a single deeply divided plate.—Type, *Aspidiotus portoricensis* Lindgr. ....  
*Crenulaspidiotus* MacG.

- jj. Plates all subequal with each other and lobes, all plates distinctly separated.—Type, *Furcaspis proteae* Brain-----*Separaspis* MacG.
- ii. Pygidium with three pairs of lobes, second and third pairs distinctly lobe-like.
  - j. Body normal in form, slightly longer than broad, as broad as long, or broader than long, never four times as long as broad.
  - k. Pygidium with caudal margin with deep pygidial incision; median pair of lobes, about one-half size of second pair, placed in incision.—Type, *Aspidiotus kellyi* Brain-----*Brainaspis* MacG.
  - kk. Pygidium with caudal margin never with pygidial incision; median pair of lobes as large as or much larger than second pair.
    - l. Ventral aspect of head, thorax, and preabdomen not with submarginal series of large setae or short conical setae.
    - m. Pygidium with pectinae between lobes.
      - n. Insects producing galls upon plants.  
*Cryptophyllaspis* Ckll.
      - nn. Insects not producing galls upon plants.—Type, *Aspidiotus fissidens* Lindgr. -----*Spinaspidiotus* MacG.
    - mm. Pygidium with plates between lobes; insects not producing galls upon plants.—Type, *Aspidiotus hellianthi* Parrott. -----*Rhizaspidiotus* MacG.
  - ll. Ventral aspect of head and thorax with a submarginal series of long stout setae and preabdomen with a band of four to six conical setae on each side.—Type, *Aspidiotus capensis* Walk.-----*Truncaspidiotus* MacG.
- jj. Body abnormal in form, length four times greatest width, head, thorax, and preabdomen distinctly more strongly chitinized than pygidium.—Type, *Aspidiotus florineides* Newst.---*Varicaspis* MacG.
- hh. Pygidium with less than three pairs of lobes.
  - i. Pygidium with two pairs of lobes.
    - j. Pygidium with median pair of lobes large and prominent, second pair of lobes smaller but lobe-like.—Type, *Aspidiotus minimus* Leon.---*Gonaspidiotus* MacG.

- jj. Pygidium with median pair of lobes short and broad, broader than long, subrudimentary; second pair of lobes long, spatulate, more than twice as long as broad, notched near distal end on lateral margin.—Type, *Aspidiotus maculata* Newst.-----  
*Paraneostocadia* MacG.
  - ii. Pygidium with single pair of lobes.
    - j. Pygidium with lobes large, projecting prominently beyond general contour of margin; each lateris with several plates or pectinae.—Type, *Aspidiotus gutierreziae* Ckll.-----  
*Chorizaspidotus* MacG.
    - jj. Pygidium with lobes not prominent, not or hardly projecting beyond general contour of margin; each lateris without plates or pectinae.—Type, *Aspidiotus chenopodii* Marl.-----  
*Rcmotaspidotus* MacG.
  - ff. Pygidium with median incisura obliterated by complete fusion of median pair of lobes.-----*Chentraspis* Leon.
- ce. Pygidium always with densariae or paraphyses.
  - f. Pygidium always with densariae.
    - g. Pygidium with three pairs of lobes; second and third pairs minute and usually pointed at distal end, sometimes plate-like.-----*Hemiberlesia* Ckll.
    - gg. Pygidium with less than three pairs of lobes.
      - h. Pygidium with densariae of second incisurae normal in form.
        - i. Pygidium with two pairs of distinct lobes.—Type, *Aspidiotus perniciosus* Comst.-----  
*Comstockaspis* MacG.
      - ii. Pygidium with only single pair of lobes.
        - j. Pygidium with unapectinae; anus located at least twice its own width from proximal end of median pair of lobes; median pair of lobes with mesal margins parallel and distant; insects producing galls upon plants.—Type, *Aspidiotus liquidambaris* Kotins.-----  
*Chemnaspidiotus* MacG.
        - jj. Pygidium with plates, if with pectinae, not with unapectinae.—Type, *Aspidiotus ulmi* Johns. -----  
*Hendaspidotus* MacG.
    - hh. Pygidium with mesal margin of densariae of each second incisura greatly enlarged, paraphysis-like, three or four times as long as lateral margin, cephalic end circular.—Type, *Aspidiotus subsimilis anonae* Houser. -----  
*Clavaspis* MacG.



- ff. Pygidium always with paraphyses.
- g. Pygidium with median incisura always present and separating median pair of lobes.
- h. Pygidium with three or four pairs of lobes and with two or more pairs of paraphyses.
- i. Pygidium with four pairs of lobes and four or more pairs of paraphyses.—Type, *Aspidiotus lilacinus* Ckll. ----- *Pelomphala* MacG.
- ii. Pygidium usually with three pairs of lobes, rarely with only two.
  - j. Body with cephalic transverse constriction bounding broad bluntly rounded head-like area. ----- *Myccasps* Ckll.
  - jj. Body with cephalic portion uniformly convex, never transversely constricted forming head-like area.
  - k. Pygidium with second pair of lobes deeply incised; pectinae long and broad, truncate at distal end.—Type, *Aspidiotus cladii* Mask. ----- *Paraonidiella* MacG.
  - kk. Pygidium with second pair of lobes not deeply incised; at most only notched; pectinae or plates or both present, if pectinae, not truncate at distal end.--- *Aonidiella* Leon.
- hh. Pygidium with single pair of lobes and one or more pairs of paraphyses.—Type, *Aspidiotus ceratus* Mask. ----- *Monaonidiella* MacG.
- gg. Pygidium with median incisura obliterated by fusion of median pair of lobes into single lobe, other lobes obsolete; with two pairs of paraphyses.—Type, *Aspidiotus extensa* Mask.----- *Neoleonardia* MacG.
- dd. Pygidium of adult female always without pectinae or plates.
- e. Pygidium always with at least one pair of lobes.
- f. Pygidium with three or four pairs of lobes.
  - g. Pygidium with four pairs of lobes and paraphyses.—Type, *Aspidiotus phyllanthi* Green.--- *Greenoidea* MacG.
  - gg. Pygidium with three pairs of lobes.
    - h. Pygidium without densariae or paraphyses; insects producing galls upon plants. *Maskellia* Fuller.
    - hh. Pygidium with densariae but without paraphyses; insects never producing galls upon plants.—Type, *Aspidiotus yuccarum* Ckll.--- *Targaspidiotus* MacG.
- ff. Pygidium with one or two pairs of lobes.
  - g. Pygidium without densariae.
    - h. Pygidium with two pairs of lobes.—Type, *Aspidiotus cedri* Green. ----- *Pygidiaspis* MacG.

- hh. Pygidium with single pair of lobes.-----  
*Targionia* Sign.
- gg. Pygidium with densariae.
  - h. Pygidium with two pairs of lobes.—Type, *Aspidiotus socotranus* Lindgr.-----*Afirmaspis* MacG.
  - hh. Pygidium with single pair of lobes.—Type, *Aspidiotus campylanthi* Lindgr.-----*Targionidea* MacG.
- ee. Pygidium without lobes, margin sometimes with angular projections or rounded protuberances but never with even inconspicuous lobes.
- f. Pygidium without parphyses or densariae.
  - g. Pygidium with caudal margin entire, coarsely crenulate, or without projections of any sort, lateral margins strongly converging caudad, forming a right angle.
  - h. Pygidium with deep mesal and lateral indentations.—Type, *Aspidiotus canaliculata* Green.  
*Circulaspis* MacG.
  - hh. Pygidium with indentations of normal depth, not with deep mesal and lateral indentations.—Type, *Diaspis arizonica* Ckll.-----*Rugaspidiotus* MacG.
- gg. Pygidium with caudal margin with thirty or more subquadrate, irregular, blunt, closely adjacent projections, lateral margins only slightly convergent caudad, forming very wide obtuse angle.—Type, *Aspidiotus rhizophilus* Newst. ----*Obtusaspis* MacG.
- ff. Pygidium with two or more pairs of parphyses.
  - g. Anus and vulva located near middle of pygidium and superimposed.—Type, *Aspidiotus pimentae* Newst.-----  
*Leonardianna* MacG.
  - gg. Anus located near middle of cephalic half of pygidium and cephalad of vulva. -----*Froggattiella* Leon.
- bb. Mesothorax and metathorax always separated by deep transverse constriction.
- c. Pygidium of adult female always with genacerores.
- d. Pygidium with dorsal aspect always without lattice-shaped thickenings.
- e. Pygidium always without parphyses.
  - f. Pygidium with four or five groups of genacerores.—Type, *Aspidiotus culculiginis* Green.-----*Stringaspidiotus* MacG.
  - ff. Pygidium always with less than four groups of genacerores.
  - g. Pygidium with three groups of genacerores; scale of adult female capsulate, posterior margin elevated by thickened ventral scale.—Type, *Aspidiotus cistuloides* Green. -----*Semelaspides* MacG.

- eg. Pygidium with two groups of genacerores; scale of adult female never capsulate.-----*Selenaspidus* Ckll.
    - ee. Pygidium always with paraphyses.—Type, *Pseudaonidea clavigera* Ckll. -----*Duplaspidotus* MacG.
  - dd. Pygidium with dorsal aspect always with lattice-shaped thickenings.
    - e. Pygidium with four or five groups of genacerores.-----  
*Pseudaonidia* Ckll.
  - ee. Pygidium with two groups of genacerores.
    - f. Pygidium without paraphyses.—Type, *Pseudaonidia paeonia* Ckll. -----*Pseudaonidiella* MacG.
    - ff. Pygidium with paraphyses.—Type, *Chrysomphalus mal-leolus* Green. -----*Paraonidia* MacG.
- cc. Pygidium of adult female never with genacerores.
  - d. Pygidium always with pectinae or plates or both.
    - e. Pygidium always without paraphyses.
      - f. Pygidium always without lattice-shaped thickenings.
        - g. Head and prothorax forming area much broader than remainder of body, head never with deep mesal incision.—Type, *Pseudaonidia magna* Lindgr.-----  
*Entaspidotus* MacG.
        - gg. Head and prothorax forming area much narrower than area formed by combination of preabdomen and remaining thoracic segments; head with deep mesal incision. -----*Schizaspis* Ckll. & Robs.
      - ff. Pygidium with lattice-shaped thickenings.—Type, *Pseudaonidia lycii* Brain. -----*Ambigaspsis* MacG.
    - ee. Pygidium always with paraphyses and lattice-shaped thickenings.—Type, *Pseudaonidia tessarata* Charm.-----  
*Lattaspidotus* MacG.
  - dd. Pygidium always without pectinae or plates.
    - e. Pygidium with four pairs of lobes and without paraphyses; segments of preabdomen distinctly constricted.—Type, *Aspidiotus artocarpi* Green. -----*Partargionia* MacG.
  - ee. Pygidium with less than four pairs of lobes.
    - f. Pygidium always with three pairs of lobes and single pair of paraphyses; preabdomen with transverse constriction between first and second segments.—Type, *Aspidiotus moorei* Green. -----*Parrotia* MacG.
    - ff. Pygidium with single pair of lobes and without paraphyses; preabdomen not with transverse constriction between first and second segments.—*Neomorgania* MacG.
- aa. Body of adult female always enclosed in puparium; pygidium of adult female frequently with pseudolobes, often with asymmetrically arranged projections, rarely with lobes and plates or pectinae.

- b. Pygidium of adult female with two groups of genacerores and with distinct lobes.—Type, *Odonaspis schizostachyi* Ckll. & Rob.-----  
*Bakeraspis* MacG.
- bb. Pygidium of adult female never with genacerores.
- c. Pygidium of second nymphal female with pectinae.
  - d. Pygidium of second nymphal female with two or three pairs of lobes and prominent laciniate pectinae on each lateris.-----  
*Greeniella* Ckll.
  - dd. Pygidium of second nymphal female with three pairs of lobes and without pectinae on each lateris.-----*Aonidia* Targ.
- cc. Pygidium of second nymphal female without pectinae.
  - d. Pygidium of adult female never with two deep parallel secondary incisions; scale always consisting of wax and a first exuvia, frequently shed from old scales; adult female enclosed in a puparium.
  - e. Pygidium of adult female with two pairs of small lobes; pygidium of second nymphal female with three pairs of lobes. -----*Xerophilaspis* Ckll.
  - ee. Pygidium of adult female with single, subquadrate, lobe-like, mesal area; pygidium of second nymphal female with single pair of lobe-like projections.—*Cryptoaonidia* Leon.---  
*Phaulaspis* Leon.
  - dd. Pygidium of adult female always with two deep, parallel, secondary incisions; scale of male and female never containing any wax; adult female and male enclosed in puparia.-----  
*Anceaspis* Ferris.

SPECIES OF OCTASPIDIOTUS

- a. Pygidium of adult female with median pair of lobes entire.
- b. Pygidium with median pair of lobes broadly rounded, not truncate, entire; second pair of lobes narrower, as long as median pair, entire; third and fourth pairs of lobes minute, pointed, much smaller than second pair; pectinae long and slender, much longer than lobes, unapectinae or latapectinae, arranged 1, 1, 1 or 2, 1 or 2, 2; genacerores (15-15)9-10.—New Zealand on *Atherosperma*...  
*atherospermae* Mask.
- bb. Pygidium with median pair of lobes truncate or slightly emarginate, not notched at distal end.
- c. Pygidium with pectinae longer than lobes; median pair of lobes truncate or slightly emarginate at distal end, not notched; second and third pairs of lobes narrower, rounded at distal end, each with lateral notch; fourth pair of lobes small, distal end acute; pectinae between lobes broad, deeply laciniate, those of each lateris long, slender, few lacinations, arranged 2, 2, 3, 3, 4 to 5; genacerores (16-18)10-12.—Australia on *Banksia*, *Eucalyptus*, *Pittosporum*.-----*subrubescens* Mask.
- cc. Pygidium with pectinae subequal or shorter than the lobes, deeply laciniate; adult female larger, more circular, pygidium

proportionately broader than in typical form; genacerores (17-27) 6-10.—Australia on Eucalyptus.-----

*subrubescens corticoides* Green.

- aa. Pygidium with median pair of lobes with prominent mesal and lateral notches, distal end rounded and prolonged between notches; second, third, and fourth pairs of lobes minute, bluntly pointed, spine-like, second pair largest; furcapectinae slightly longer than lobes, arranged 0, 1-2, 2, 2-3, 3; spiracerores wanting; genacerores (2-4) 1-3.—South Africa on Acacia. -----*furcillae* Brain.

#### SPECIES OF ASPIDIOTUS

- a. Pygidium with median pair of lobes shorter than either of other pairs, not projecting nearly as far caudad, short and narrow, each with lateral notch; second and third pairs of lobes narrow, bluntly rounded, each with lateral notch; pectinae longer than lobes, unapectinae, those of each lateris broad, arranged 2, 2, 3, 6 to 7; genacerores (6-16) 3-9; anus distant from caudal margin three times its own diameter; linaceratubae variable in length, with exception of few mesal ones, eight or more times as long as broad.—West Indies, Mexico, China, Formosa, India, Laccadive Islands, Ceylon, Bourbon Islands, Mauritius on Celtis, Terminalia, Alcocasia, Psychotria, Manihot, Loranthus, Moesa, tea, pepper, palms, mango, banana, nutmeg, etc. -----*destructor* Sign.
- aa. Pygidium with median pair of lobes at least as long as second pair, usually distinctly longer, at least projecting farther caudad.
- b. Pygidium with lobes spatulate, constricted at proximal end, widened at middle, narrowed at distal end, subequal in size, entire; pectinae located between lobes and along each lateris for almost its entire length, arranged 1, 1, 2, 7 or more; genacerores (17-21) 8-13.—Australia on Eugenia. -----*virescens* Mask.
- bb. Pygidium with lobes not spatulate, wider at proximal than at distal end.
- c. Pygidium with third pair of lobes with margins entire.
- d. Pygidium with third pair of lobes not deeply incised.
- e. Pygidium with prominent, truncate, serrate, lobe-like projection near middle of each lateris and with seta near its lateral margin; median pair of lobes rounded, prominent, slight lateral notch; second and third pairs of lobes smaller, lateral margins oblique, lateral margin of third pair serrate; pectinae subequal in length to lobes, arranged 1, 2, 3, 3, caudal pectina of each lateris broader than others; genacerores 3-5 (8-8) 2-5.—California on Pinus.-----*californicus* Colem.
- ee. Pygidium not with prominent lobe-like projection near middle of each lateris.
- f. Pygidium with pectinae on each lateris.
- g. Pygidium with median pair of lobes projecting distinctly farther caudad than second pair.

- h. *Pygidium* with pectinae or plates in median incisura.
- i. *Pygidium* with two pectinae in median incisura.
- j. *Pygidium* with genacerores (6-14)5-11.
- k. *Pygidium* with median pair of lobes distinctly longer than broad.
  - i. *Pygidium* with each lateris with three pectinae; median pair of lobes long and broad, broadly rounded, mesal and lateral notches, latter largest; second pair of lobes large, blunt, rounded, lateral notch; third pair of lobes small, triangular; pectinae of third incisurae longer than lobes, unapectinae, others subequal, arranged 2, 2, 3, 3, those of each lateris narrower; genacerores (6-8)5-5.—New Mexico on *Chilopsis*.-----*coloratus* Ckll.
  - ii. *Pygidium* with each lateris with seven or eight pectinae; median pair of lobes elongate, distinctly longer than broad, distinct mesal and lateral notches, distal end bluntly pointed; second pair of lobes smaller, longer than broad, distinct lateral notch, distal end bluntly pointed; third pair of lobes subequal to second; triangular, entire; pectinae deeply lacinate, arranged 2, 2, 3, 7-8, those of third incisurae and lateres unapectinae; anus distant from caudal margin four times its width; genacerores (12-14)9-11.—Dahomey, Africa on *Elaeis*.-----*elacidis* Marchal.
- kk. *Pygidium* of adult female with median pair of lobes as broad as or broader than long.
  - i. *Pygidium* with only a single pectina cephalad of each third lobe; median pair of lobes broader than long, quadrangular, deep lateral and faint mesal notches, distal margin rounded; second pair of lobes broadly rounded, broader than long, distinct lateral notch; third pair of lobes minute, bluntly rounded, entire; setae large, longer than lobes; pectinae subequal in length or slightly longer than median lobes, arranged 2, 2, 2, 1; lateres distinctly crenulate; genacerores (6-6)5-6.—Specimens from Madagascar have lobes longer, entire, longer pectinae, and genacerores (2-4)4-8.—German East Africa, Madagascar on *Cocos*.-----*varians* Lindgr.

- ii. Pygidium with four to six pectinae cephalad of each third lobe; median pair of lobes large, prominent, obscure mesal and lateral notches, distal margin bluntly produced between them; second and third pairs of lobes small, triangular, pointed; pectinae slightly longer than the lobes, arranged 2, 2, 3, 4-6; anus distant from caudal margin four times its width; oraceratubae conspicuous, arranged in longitudinal rows; genacerores 1-3(10-14)5-7.—Australia on Ribes, Ampelopsis, Eucalyptus, Acacia, Cytisus.-----  
*tasmaniae* Green.
- jj. Pygidium with genacerores (3-4)2-3, said to be in five groups; median pair of lobes broad and stout; second pair of lobes dentiform, lateral margin strongly oblique; third pair of lobes reduced to tooth of margin; setae long and stout, longer than plates and pectinae.—Corsica on Stachys, Teucrium.-----  
*labiatarum* Marchal.
- ii. Pygidium with two plates in median incisura; median pair of lobes long, broad, quadrangular, broadly rounded, mesal and lateral notches prominent, second pair of lobes longer than broad, bluntly rounded, lateral and possibly median notch; third pair of lobes elongate, half as long as second pair, triangular; plates and pectinae arranged 2, 2, 2, 5-7, plates of median incisura as long as median lobes, others broadly deeply laciniate distapectinae; setae very long and stout, particularly those of second and third pairs of lobes; genacerores (3-6)3-6.—District of Columbia, England on Camellia, Arenga.-----  
*spinus* Comst.
- hh. Pygidium without pectinae or plates in median incisura; median pair of lobes large, stout, prominent, irregularly and obscurely excised; second and third pairs of lobes minute, proximal portion broad and distal portion aciculate; pectinae stout, varying from deeply furcate furcapectinae to plates, arranged 0, 2, 2, 6-9; setae long, stout, longer than pectinae; spiracerores wanting; genacerores (8-11)3-6; anus located slightly nearer caudal margin than a line drawn through postgenacerores.—Java on Erythrina.-----  
*pustulans* Green.
- gg. Pygidium with median pair of lobes projecting but little if any farther caudad than second pair, broad, distal ends truncately rounded, faint mesal and lat-

eral notches; second pair of lobes large, broad, smaller than median, distal margin undulate; third pair of lobes similar to second in form, smaller, margin undulate; pectinae short, those of each third incisura longer than lobes, other pectinae distapectinae, arranged 2, 2, 3, 3; genacerores 0-3 (8-12) 6-9.—Europe, Maine, Massachusetts, New York, New Jersey, Georgia on hemlock, pine, fir, maple.-----*abietis* Schr.

ff. Pygidium without pectinae on each lateris.

g. Pygidium with median pair of lobes entire, large, rounded; second pair of lobes small, similar in shape to median; third pair of lobes minute, rounded, entire; pectinae subequal in length with median lobes, arranged 2, 2, 1, 0, those of third incisurae broadest; each third incisura with latadentis-like projection; genacerores (3-7) 3-7.—California on Pinus.-----*florenciae* Colem.

gg. Pygidium with median pair of lobes with prominent lateral notch, sometimes faint mesal notch, subquad-rangular, wide, distal end truncately rounded; second and third pairs of lobes small, projecting, angular, long; setae stout, projecting beyond median lobes; pectinae narrow, subequal in length with median lobes, arranged 2, 2, 2, 1-2, each lateris irregular in outline with one or two minute plates placed distant from each other and third lobe; genacerores (2-6) 2-4; anus three times its own width from caudal margin.—Italy, Greece on Hypericum, Thymelaea.-----*privignus* Lindgr.

dd. Pygidium with third pair of lobes deeply incised.

e. Pygidium with only third pair of lobes incised; third pair of lobes consisting of two adjacent conical lobelets; median pair of lobes large, triangular, margins serrate, distant; second pair of lobes small, triangular, adjacent to median lobe, appearing as deeply incised lateral lobelet; median and second incisurae without pectinae or plates, each third incisura with long furcapectina, each lateris adjacent to third lobe with another similar furcapectina and few plates on cephalic portion; genacerores (6-10) 15-15.—Fiji Islands on "various forest trees."-----*vitiensis* Mask.

ee. Pygidium with second and third pairs of lobes deeply incised.

f. Pygidium with three pairs of lobes; scale of adult female oval, larger near one end, exuviae placed on smaller end; median pair of lobes moderately large, distant; lateres thick and serrate; two plates between median pair of lobes and on margin between other lobes; setae short; dorsal oracratubae numerous; genacerores (25-



39)31-35; ordinarily with one to five cerores between anterior groups.—Brazil on *Drymus*.—See next species.

*pisai* Hemp.

- ff. *Pygidium* with four pairs of lobes; scale of adult female more or less circular, flattened, exuviae placed little to one side of center; median pair of lobes smallest; second, third, and fourth pairs deeply incised, mesal lobelet of second and third pairs largest, lobelets of third pair subequal; plates and pectinae arranged 2, 1, 1, 1, 12, median incisura with plates, other incisurae with furcapectinae, and lateres with plates grouped near fourth lobe; genacerores 16-18(16-30)16-21; also two to three glands at sides of pregenacerores.—Brazil on *Drymus*.—This species and the preceding one do not appear like species of this tribe.-----*moreirai* Hemp.

cc. *Pygidium* with third pair of lobes with margins notched.

d. *Pygidium* with four or five groups of genacerores, if with four groups, number of cerores in groups very dissimilar.

e. *Pygidium* with six or more pectinae on each lateris.

f. *Pygidium* with three pectinae in each third incisura.

g. *Pygidium* with second and third pairs of lobes distinctly broader than long; median pair of lobes projecting, bluntly rounded, faint lateral notch; second and third pairs of lobes much shorter than median, lateral margin strongly oblique, finely serrate; pectinae subequal in length to lobes, arranged 2, 2, 3, 7, those of each lateris unapectinae; genacerores 4-5(7-8)4-5.—Japan on *Cryptomeria*.---*cryptomeriae* Kuwn.

gg. *Pygidium* with second and third pairs of lobes distinctly longer than broad.

h. *Pygidium* with anus distant from caudal margin about four times its width.

i. *Pygidium* with two pectinae in median incisura.

j. *Pygidium* with longest linaceratubae not more than four times as long as wide; median pair of lobes round, large lateral and smaller mesal notches; second and third pairs of lobes variable in form, second pair rounded and notched, third pair bluntly pointed, faintly notched; pectinae longer than lobes, arranged 2, 2, 3, 6, those of median and second incisurae and caudal pectina of third incisurae distapectinae, others unapectinae; genacerores (8-15)4-10.—*Aspidiotus hederæ simplex* Charm.—Canada, United States, Mexico, West Indies, Southern Europe, Africa, Australia, etc. on orange, lemon, olive, palms, orchids, cherry, plum, currant, maple, and many other plants.-----*hederæ* Vall.

- jj. Pygidium with linaceratubae eight to ten times as long as wide.
- k. Pygidium with genacerores (7-9)8-15; median pair of lobes rounded with large lateral and feeble mesal notches; second pair of lobes narrower and almost entire; third pair of lobes smaller and notched on outer side; median lobes extend farther caudad than second pair; pectinae arranged 2, 2, 3, 6, those of each lateris about twice as long as a third lobe; anus slightly nearer postgenacerores than caudal margin.—Australia on palm.-----*simillimus* Ckll.
- kk. Pygidium with genacerores (6-11)4-6; median pair of lobes largest, mesal and lateral notches not prominent, distal end rounded between notches, subequal in length to second pair; second and third pairs slender, longer than broad, constricted on proximal portion, distinct lateral notch; pectinae subequal in length or slightly longer than lobes, arranged 2, 2, 3, 6-7, those of each lateris unapectinae; spiracerores wanting; caudal portion of lateres toothed, cephalic portion entire; linaceratubae long, distinct, opening at margin.—Aspidiotus simillimus translucens Fern.—Ceylon, Hawaiian Islands on Loranthus, Dahlbergia.-----*transparens* Green.
- ll. Pygidium with single pectina in median incisura; median pair of lobes long and projecting, subquadrangular, longer than broad, deep lateral notch, distal portions rounded, converging caudad, almost contiguous; second pair of lobes small, longer than broad, deep lateral notch; third pair of lobes smaller than second, similar in form, deeply notched; pectinae of median and second incisurae narrow, distapectinae, others unapectinae, arranged 1, 2, 3, 6; anus over four times its width from caudal margin; genacerores (7-9)6-8—Philippine Islands on Corpyha.  
*coryphae* Ckll. & Rob.
- hh. Pygidium with anus distant from caudal margin six or seven times its width.
- i. Pygidium with genacerores (0-2)0-2; median pair of lobes elongate, longer than broad, distal end rounded, distinct lateral and faint mesal notches; second pair of lobes similar in shape, notches smaller; third pair of lobes longer than broad, one or two lateral notches, blunt-

- rounded; pectinae subequal in length to median pair of lobes, deeply laciniate, arranged 2, 2, 3, 6-8, those of each lateris near third lobe, unapectinae; setae not as long as lobes; dorsal oracreratubae numerous on each side.—Canary Islands on *Dracaena*, *Gymnosporia*, *Ilex*, *Oreodaphne*, *Picconia*, *Smilax*, *Hedera*, *Apollonias*, *Heberdenia*, *Laurus*.-----*lauretorum* Lindgr.
- ii. Pygidium with genacerores 0.3 (4-14) 4-13.
- j. Pygidium with genacerores (11-14) 11-13; median pair of lobes longer than broad, broadly rounded, faint mesal and lateral notches; second and third pairs of lobes subequal, slightly smaller than median, similar in form, distinct mesal and lateral notches; pectinae broad, distapectinae, longer than lobes, arranged 2, 2, 3, 8-9; each lateris finely serrate cephalad of pectinae; dorsal oracreratubae numerous, irregularly arranged.—Australia on *Eugenia*.-----*fimbriatus* Mask.
- jj. Pygidium with genacerores 0.3 (5-10) 4-10; pectinae deeply laciniate, longer than lobes, arranged 2, 2, 3, 8-12, those of incisurae distapectinae, others unapectinae.—South Africa on Cycads, *Encephalartos*.-----*fimbriatus capensis* Newst.
- ff. Pygidium with two pectinae in each third incisura; median pair of lobes broad, broadly rounded, mesal and lateral notches; second pair of lobes similar, smaller, mesal and lateral notches; third pair of lobes sometimes irregular, smaller than second, usually with lateral margin only or with distal margin notched; pectinae short, arranged 2, 2, 2, 6, those of incisurae bifurcate or trifurcate, those of each lateris slightly laciniate unapectinae; genacerores 0.3 (7-10) 7-8.—England, Massachusetts, Oregon on *Ruscus*, holly.-----*britannicus* Newst.
- ee. Pygidium with four pectinae on each lateris.
- f. Pygidium with median pair of lobes quadrangular, broader than long.
- g. Pygidium with median pair of lobes entire, broad, quadrangular, broadly truncated; second and third pairs of lobes quite small, much shorter than pectinae, bluntly rounded, entire; pectinae deeply laciniate, arranged 2, 2, 3, 4, those of each lateris longest; dorsal oracreratubae not numerous; anus distant from caudal margin six to seven times its width; genacerores (6-8) 5-7.—Mexico on ash. -----*vagabundus* Kkll.
- gg. Pygidium with median pair of lobes with distinct mesal and lateral notches, distal end rounded; second

pair of lobes smaller, similar in shape, distinct mesal and lateral notches; third pair of lobes about one-half size of second, similar in shape; pectinae broad, arranged 2, 2, 3, 3-4, those of incisurae subequal to lobes, those of lateres much longer than lobes; genacerores (2-5)3-4.—South Africa on aloe.—*regius* Brain.

- ff. Pygidium with median pair of lobes elongate, much longer than broad, mesal margin entire or with one faint notch and lateral margin with two to four notches; second and third pairs of lobes large, nearly as large as median, elongate, similar in form, similar notches; pectinae deeply laciniate, much longer than lobes, arranged 2, 2, 3, 4, those of each lateris subequal in length, more irregular than others; anus distant from caudal margin seven or eight times its own width; genacerores (2-4) 2-4.—Canary Islands on *Gymnosporia*.-----

*gymnosporiae* Lindgr.

- dd. Pygidium of adult female with four groups of genacerores, (6-6)6-6; median pair of lobes close together, parallel, not quite touching, considerably longer than broad, rounded, ends minutely serrate; second pair of lobes similar, smaller, ends serrate, their ends extending to line drawn through caudal margin of median lobes; third pair of lobes small, lateral notch; pectinae serrate and branched, seven on each lateris; setae large, not longer than pectinae; anus small, close to proximal end of median pair of lobes.—Hawaiian Islands, Japan on *Persea*, *Trachycarpus*, *Magnolia*.----*perscarum* Ckll.

#### SPECIES OF TEMNASPIDIOTUS

Pygidium with median pair of lobes large, distal margins oblique, slightly emarginate; second pair of lobes long and slender, projecting beyond median pair, less than one-half width of median pair, shorter, narrow, pointed; third pair of lobes similar to second pair, shorter and blunter; pectinae deeply laciniate, unapectinae, arranged 2, 2, 3, 4; spiracerores wanting; anus three times its own width from vulva and five times from caudal margin; genacerores (8-15)7-9.—Ceylon on *Cyanotis*.-----  
*excisus* Green.

#### SPECIES OF ASPIDIELLA

- a. Pygidium with either pectinae or plates in median incisura.
- b. Pygidium with pectinae in median incisura.
- c. Pygidium with pectinae in each second incisura.
- d. Pygidium with median pair of lobes with mesal and lateral notches.
- e. Pygidium with second pair of lobes entire.
- f. Pygidium with anus not more than twice its own width from caudal margin; median pair of lobes quadrangular, distinct mesal and lateral notches; second pair of lobes small, longer than wide, entire, bluntly rounded; pectinae long and slender, subequal in length or slightly

longer than lobes, two to five teeth, arranged 2, 2, 6-10, caudal three or four of each lateris unapectinae, cephalic two to four plates; dorsal oracerratubae numerous; genacerores (5-7)3-6; setae large and prominent, projecting beyond lobes.—Florida on saw palmetto.-----

*pseudospinosa* Woglum.

- ff. Pygidium with anus five or more times its own width from caudal margin; median pair of lobes quadrangular, distinct mesal and lateral notches; second pair of lobes long and narrow, longer than broad, entire, bluntly rounded; pectinae long, subequal in length to lobes, those of median incisura narrow, arranged 2, 2, 6-8, three caudal pectinae of each lateris longest and broadest, those cephalad of these much shorter, varying from furcapectinae to plates; dorsal oracerratubae numerous; genacerores (9-12)6-8; setae small, not projecting beyond lobes.—New Jersey on *Oxycoccus*.-----*oxycoccus* Woglum.
- ee. Pygidium with second pair of lobes with notch.
  - f. Pygidium with seven or eight pectinae on each lateris; median pair of lobes large, broadly rounded, proximal portion constricted, distinct mesal and lateral notches; second pair of lobes strongly constricted on proximal portion, distal portion broadly rounded, lateral shoulder and lateral notch; with shoulder-like thickening, may represent third lobe; pectinae subequal in length to lobes, deeply toothed, arranged 2, 2, 7-8, those of each lateris adjacent to second lobe; dorsal oracerratubae prominent; genacerores 2-4(3-3)3-4; mesal calles oblique, not so distinct as oblique lateral calles; anus about twice its own width from caudal margin.—China on Abies. -----*meyeri* Marl.
  - ff. Pygidium with three pectinae on each lateris; median pair of lobes short and broad, quadrangular, prominent lateral and mesal notches, distal margin bluntly rounded; second pair of lobes broader than long, oblique, feebly crenulate or notched; pectinae subequal in length to median lobes, narrow, deeply lacinate, arranged 2, 3, 3, those of each lateris adjacent to third lobe; anus oval, near median lobes; genacerores 4-4(7-7)3-4.—California on *Arctostaphylos*.-----*arctostaphyli* Ckll. & Rob.
- dd. Pygidium with median pair of lobes entire or with lateral notch only.
- e. Pygidium with median pair of lobes about as broad as long, broadly rounded, mesal margins divergent, entire or with indistinct lateral notch; second pair of lobes much smaller, subminute, triangular; pectinae with few lacinations, arranged 2, 2, 7, caudal pectinae distinctly lacinate, cephalic two or three modified into plates; lateres serrate cephalad of plates; genacerores 3-4(8-9)5-7.—*Aspidiotus hartii* Luntii Ckll.—West Indies on yam. -----*hartii* Ckll.

- ee. Pygidium with median pair of lobes longer than broad, bluntly rounded, distinct lateral notch; second pair of lobes similar in form, one-half size first pair, lateral notch broad; pectinae subequal in length to lobes, arranged 2, 2, 3, those of each lateris largest; dorsal oracratubae prominent; anus distant four or five times its width from caudal margin; genacerores 0-3 (5-6) 3-5.—California on Quercus, Pasania. -----*densiflorae* Bremner.
- cc. Pygidium with plates in each second incisura; median pair of lobes large, projecting, rounded, mesal margins parallel, prominent lateral notch; second pair of lobes much smaller, about as broad as long, distal margin sinuate; two minute furcapectinae in median incisura, shorter than or subequal to lobes, two plates in second incisurae, and three pectinae on each lateris; lateres cephalad of pectinae denticulate; genacerores (7-9) 7-9.—West Indies on Saccharum. -----*sacchari* Ckll.
- bb. Pygidium with plates in median incisura.
  - c. Genacerores (5-5) 5-5; median pair of lobes large, prominent, distant, rounded, lateral notch; second pair of lobes small, rounded; pectinae small, poorly developed, similar to plates, arranged as in hederæ, thus 2, 2, 3, 6; genacerores (5-5) 5-5.—Chili. -----*latastei* Ckll.
  - cc. Genacerores 0-1 (8-12) 6-9; median pair of lobes large; second pair of lobes much smaller; plates present between the lobes; dorsal oracratubae numerous, arranged in four rows on each side, extending from margin, those of same row varying greatly in length.—Spain on walnut. -----*juglandis* Colvee.
- aa. Pygidium without pectinae or plates in median incisura.
  - b. Pygidium with second pair of lobes longer than median, projecting farther caudad, rounded at distal end, entire; median pair of lobes longer than broad, faint lateral and mesal notches, bluntly rounded; pectinae broad, deeply laciniate, arranged 0, 1, 4, caudal pectina of each lateris very broad, others narrow; anal opening about twice length of median lobes from caudal margin; genacerores (5-6) 4-4.—New York, Ohio, Illinois, Iowa on maple.-----*comstocki* Johns.
  - bb. Pygidium with median pair of lobes extending much farther caudad than second pair, quadrangular, mesal and lateral notches, adjacent; second pair of lobes broad, distal end oblique, subtruncate, slightly emarginate; pectinae longer than lobes, arranged 0, 2, 2; genacerores (3-4) 2-3.—Jamaica, Dominica, New York, Iowa on cocconut, pomegranate.-----*punicæ* Ckll.

SPECIES OF UNASPIDIOTUS

Pygidium with median pair of lobes dark yellowish brown, subadjacent, feebly convergent, projecting far, no mesal notch, single lateral notch; other lobes replaced by short, colorless, plate-like, one or two pointed processes; plates and pectinae numerous, colorless, undivided, blunt, last three frequently somewhat thickened, those near median pair of

lobes more or less deeply forked; genacerores 0.4(7-10)7.8.—Japan on Pinus. .... *corticis-pini* Lindgr.

## SPECIES OF ASPIDOIDES

- a. Pygidium with median pair of lobes entire.
  - b. Pygidium with median pair of lobes large, long and broad, quadrangular, distal margin bisinuate; second pair of lobes much smaller, elongate, bluntly pointed, slight mesal notch; third pair of lobes triangular, as broad as long, entire; pectinae longer than lobes, deeply laciniate, mostly unapectinae, arranged 2, 2, 3, 4, those of each lateris in two groups; genacerores in two groups of two pores each; anus located near margin of pygidium.—New Zealand on Corokia. .... *corokiae* Mask.
  - bb. Pygidium with median pair of lobes rectangular, entire, distal end oblique; second and third pairs of lobes bluntly rounded, constricted at proximal end, with an outer shoulder, entire; pectinae normal in form, subequal in length to lobes, arranged 2, 2, 3, 2-4, those of each lateris adjacent to third lobe; anus large, located near middle of pygidium; genacerores represented only by two groups of 1-4 cerores, probably represent pregenacerores; dorsal oracera-tubae numerous.—Australia on Hake. .... *comperci* Marl.
  - aa. Pygidium with median pair of lobes with mesal and lateral notches, quadrangular, distal end broadly rounded; second pair of lobes smaller, similar, unsymmetrical with short oblique margin; third pair of lobes smaller than second, somewhat pointed; pectinae of median and second incisurae as long as median lobes, furcapectinae, others deeply laciniate, those of each lateris longest, cephalic four often short, arranged 2, 2, 3, 4-5; genacerores arranged in two groups of 4-6 cerores.—Canary Islands on Olea. .... *tafranus* Lindgr.

## SPECIES OF MARLATTASPIS

Pygidium with median pair of lobes sloping inwards, outer margin of each with conspicuous notch and smaller notch on rounded lateral margin at distal end; each lateris with two deep indentations cephalad of lobes, and several pectinae, some are simple, plate-like and others are broad and conspicuously forked; genacerores one or two on each side and sometimes with a single mesogenaceroris.—China on Campanula. .... *implicata* Mask.

## SPECIES OF FURCASPIS

- a. Pygidium with median and second pairs of lobes subequal.
  - b. Pygidium with each lateris produced near middle of its length into prominent tooth-like projection with single furcapectina cephalad of it; median pair of lobes quadrangular, broadly rounded, subtruncate, entire; second pair of lobes similar in size and shape to median; third pair of lobes similar in shape to second, smaller; pectinae subequal in length to lobes, furcapectinae, arranged 2, 2, 3, 1, those of each lateris distant from third lobe; second and third incisurae with densariae; genacerores (4-5)4.4.—*Chrysomphalus biformis* Ckll., *Aspidiotus biformis* odontoglossi

Ckll., *Chrysomphalus odontoglossi* Ckll., *Chrysomphalus biformis* cattleyae Ckll.—Central America, Jamaica, Trinidad, Grenada, Antigua on orchids. ----- *biformis* Ckll.

- bb. Pygidium with each lateris not produced into a tooth-like projection near middle of its length.
  - c. Pygidium with five to six pectinae on each lateris near a third lobe, unapectinae, subequal in length to lobes, arranged 2, 2, 3, 5-6; median pair of lobes subquadrangular, usually with mesal notch, lateral margin oblique, minutely serrate; second pair of lobes subequal in size, lateral margin oblique, finely serrulate; third pair of lobes slightly smaller than second pair, lateral margin oblique, finely serrulate; anus located midway between vulva and caudal margin; genacerores (11-14) 7-9.—Japan on *Quercus*. ----- *jordani* Kuwn.
  - cc. Pygidium without pectinae on each lateris, pectinae broad, subequal to lobes in length, arranged 2, 2, 3, 0; median pair of lobes subquadrangular, truncately rounded, entire; second pair of lobes similar in form and subequal in size; third pair of lobes bluntly pointed, smaller than second, lateral margin oblique, serrate; anus distant from caudal margin over twice its own width; densariae in median, second, and third incisurae, those of second longest; genacerores 2-4(5-7) 4-5; dorsal oracrerutabae numerous.—Japan on *Tsuga*. ----- *tsugae* Marl.
- aa. Pygidium with median pair of lobes much larger than second pair.
  - b. Pygidium with five or more pectinae on each lateris.
    - c. Pygidium with pectinae of median incisura distinctly longer than median pair of lobes; median pair of lobes quadrangular, subtruncate, deep mesal and lateral notches; second pair of lobes narrow, pointed, nearly as long as median pair, not one-half as wide; third pair of lobes much shorter than second pair, narrow, bluntly pointed; pectinae deeply laciniate, arranged 2, 2, 3, 5, apparently all latapectinae; genacerores (4-6) 5-6.—West Indies on coconut palm, banana. ----- *palmae* Morg.
    - cc. Pygidium with pectinae of median incisura but little if any longer than median lobes; median pair of lobes quadrangular, rounded, distinct mesal and lateral notches; second pair of lobes much shorter and about one-third width of median, bluntly pointed, sometimes faintly notched; third pair of lobes minute, pointed; pectinae deeply laciniate, arranged 2, 2, 3, 3, those of each lateris deeply divided, strongly furcate, those of median and second incisura furcapectinae; genacerores (3-5) 3-5.—Massachusetts, District of Columbia, Ohio, Mexico, Brazil, Venezuela, England, France, Ceylon, Mauritius on *Cyanophyllum*, *Ficus*, *Laurus*, *Cycas*, *Ipomoea*, *Pritchardia*, *Cinchona*, palms, orchids, tea. ----- *cyanophylli* Sign.
- bb. Pygidium never with more than three pectinae on each lateris.
  - c. Pygidium with pectinae or plates on each lateris.
  - d. Pygidium with two or three pectinae on each lateris.



- e. Pygidium without densariae between median pair of lobes; two or three pectinae in each third incisura; median pair of lobes quadrangular, rounded, distinct mesal and lateral notches; second pair of lobes smaller, rounded, narrower, mesal and lateral notches; third pair of lobes smaller, bluntly rounded, lateral notch; pectinae deeply lacinate, arranged 2, 2, 2-3, 2-4, those of each lateris latapectinae, those of median and second incisurae as long as lobes, distapectinae; genacerores 0.2(4-9)3.5.—*Aspidiotus osbeckiae* Green.—India, Ceylon on *Atylosia*.-----  
*orientalis* Newst.
- ee. Pygidium with densariae between median pair of lobes.
- f. Pygidium with second pair of lobes smaller than median, subspatulate, longer than broad, bluntly rounded, faint mesal and lateral notches; median pair of lobes quadrangular, distal end bluntly rounded, distinct mesal and lateral notches; third pair of lobes smaller than second, subspatulate, bluntly pointed, sometimes faint lateral notch; pectinae deeply lacinate, slightly shorter to slightly longer than lobes, arranged 2, 2, 3, 3, those of each lateris deeply lacinate unapectinae, located adjacent to third lobe; anus four or five times its own width from caudal margin; genacerores 0.1(3-8)3.5; dorsal oracratubae in two rows on each side; each lateris with three small serrated projections.—Cuba on *Cocos*, *Citrus*.-----*cocotiphaga* Marl.
- ff. Pygidium with second pair of lobes short, much broader than long, oblique, mesal angle pointed or rounded; third pair of lobes smaller than second, similar in form, as broad as or broader than long; median pair of lobes large, quadrangular, distal end bluntly rounded, distinct mesal and lateral notches; pectinae subequal in length to median pair of lobes, narrow, deeply lacinate, arranged 2, 2, 1-3, 3, those of each lateris not adjacent, not adjacent to third lobe; anus about three times its own width from caudal margin; genacerores (0.4)0.2, usually (1.2)1.2.—South Africa on *Acacia*, *Acer*, *Berberis*, *Ceratonia*, *Cotoneaster*, *Crataegus*, *Gleditschia*, *Rhus*, pear, privet, alder, almond, apple, apricot, ash, persimmon, plum, poplar, quince, pepper, willow.-----  
*pectinata* Lindgr.
- dd. Pygidium with single pectina on each lateris; median pair of lobes quadrangular, faint mesal and lateral notches, distant, broader than long; second pair of lobes short and broad, twice as broad as long, smaller than median, mesal and lateral notches; third pair of lobes rudimentary, hardly projecting, crenulate; pectinae slender, arranged 2, 2, 3, 1, those of median incisura narrow furcapectinae, all others unapectinae, those of each lateris distant from third lobe; genacerores 0.2(4-9)7-10.—Italy on cherry.-----*patavina* Berl.

- cc. Pygidium without pectinae or plates on lateres.
- d. Pygidium with an oblique row of oraceratubae extending cephalad from each third incisura, laterad of this another row of irregularly alternate pores and none from second incisurae; median pair of lobes subquadrangular, with small mesal and large lateral notch, rounded; second pair of lobes small, broader than long, lateral margin oblique, notched; third pair of lobes similar to second, wider; median incisura with spine-like plates, each second incisura with two plates or two furcapectinae or finely laciniate unapectinae or one plate and one furcapectina; setae only slightly longer than lobes; genacerores 0.4(8-14)5-11.—Europe on oak.-----  
*zonata* Frauent.
- dd. Pygidium with oblique row of oraceratubae extending cephalad from each third incisura, cephalad of this another row of irregularly arranged pores and a row of about five oraceratubae from each second incisura.
- e. Pygidium with genacerores arranged 0.8(10-14)8-11; median pair of lobes subquadrangular, large lateral notch or sinuate, rounded; second pair of lobes small, longer than broad, lateral margin oblique, two lateral notches; third pair of lobes minute, bluntly pointed; pectinae short, those of median and second incisura not longer than lobes, furcapectinae, arranged 2, 2, 3, 0, those of each third incisura unapectinae; setae very long, much longer than lobes; genacerores 0.8(10-14)8-11.—*Aspidiotus juglandis* Colvée, *Aspidiotus juglans-regiae* albus Ckll., *Aspidiotus juglans-regiae kaffae* Ckll.—United States east of Rockies, Canada, New Mexico, California, Switzerland, Spain on walnut, apricot, apple, pear, peach, cherry, plum, locust, maple, etc. -----*juglans-regiae* Comst.
- ee. Pygidium with genacerores arranged 0.1(6-7)5-7; four series or rows of oraceratubae.—New Mexico on plum, Liquidambar. -----*juglans-regiae pruni* Ckll.

SPECIES OF QUADRASPIDIOTUS

- a. Pygidium with six or more pectinae on each lateris.
- b. Pygidium with two caudal pectinae of each lateris longer than cephalic pectinae.
- c. Pygidium with six pectinae on each lateris, three caudal much larger than three cephalic, pectinae forming a scaly fringe in region of lobes; median pair of lobes largest, not contiguous; anus large, about twice its own length from caudal margin; genacerores (4-8)5-5.—Arizona, Mexico on ash....*townsendi* Ckll.
- cc. Pygidium with pectinae long, scarcely laciniate or dentate, four caudal pectinae of each lateris much larger than three cephalic; median pair of lobes large, prominent, adjacent, not touching; obliquely truncate, distinct lateral and faint mesal notches; second pair of lobes small, broad, mesal angle longest; mesal

- densariae of second incisura largest; pectinae small, about five, arranged 2, 0, 3; dorsal oracratubae conspicuous; genacerores (6-7)2-4.—Colorado, New Mexico on plum.....*howardi* Ckil.
- bb. Pygidium with pectinae and plates of each lateris subequal in size; median pair of lobes large, quadrangular, distinct lateral and mesal notches; second pair of lobes one-third or less the width of median lobes, shorter, small lateral and mesal notches, hyaline; small third pair of lobes sometimes present; pectinae subequal in length to lobes, arranged 2, 2, 5-6, those of incisurae and three cephalad of each second lobe furcapectinae, others plates; genacerores 0-1(4-7)4-6; densariae not prominent, subequal.—Virginia, Ohio on Epigaea. ....*epigaeae* Marl.
- aa. Pygidium never with more than three pectinae or plates on each lateris.
- b. Pygidium with plates in median incisura.
- c. Pygidium with second pair of lobes small, usually narrow, longer than broad, if broader than long, never twice as broad as long.
- d. Pygidium with mesal and lateral margins of second densariae subequal in length.
- e. Pygidium with median pair of lobes quadrangular, broader than long, rounded, prominent lateral notches, mesal margins suboblique; second pair of lobes usually as broad as, sometimes broader, than median, but much shorter, lateral margin oblique and emarginate or irregularly notched; median incisura with two short plates, each second incisura with two plates or finely serrate pectinae, each lateris with two plates or two furcapectinae in third incisura and a single unapectina; setae long, particularly those of second pair of lobes; genacerores 5-8(10-12)10-16; anus five times its width from caudal margin.—*Aspidiotus ostreaeformis oblongus* Goethe, *Aspidiotus ostreaeformis magnus* Goethe.—British Columbia, Idaho, California, Eastern Canada, New York, Michigan, Europe on apple, pear, plum, peach, cherry, birch, poplar, horse-chestnut, linden, alder, maple, oak, date-palm, Crataegus, Calluna....*ostreaeformis* Curtis.
- ee. Pygidium with the median pair of lobes projecting, more or less parallel, longer than broad, distal end uniformly reduced, mesal and lateral notches; second pair of lobes very small, broad with irregular margin; genacerores always in four groups, (4-11)3-9; other structures assumed to be same as in *ostreaeformis*.—Bavaria, Prussia, Austria, Norway, England, Portugal on Calluna, Erica.....*bavaricus* Lindgr.
- dd. Pygidium with mesal margins of second densariae longer than lateral; median pair of lobes wide, sometimes with lateral notch; second pair of lobes with prominent mesal angle, distal margin oblique, one to four notches; plates small, arranged 2, 2, 3; genacerores 2-6(5-12)5-7.—*Aspidiotus fernaldi albiventer* Hunter, *Aspidiotus fernaldi hesperius*

- Ckll.—Massachusetts, Kansas, Arizona on Juneberry, maple, Gleditschia. -----*fernaldi* Ckll.
- cc. Pygidium with second pair of lobes twice or more as broad as long, projecting only slightly, entire or more or less serrate; median pair of lobes broad, short, entire, broader than long, hardly projecting; incisurae not prominent; densariae in median incisurae prominent, mesal margin of second and third densariae broader than lateral, second densariae longer than median; pectinae not as long as lobes, furcapectinae, arranged 2, 2, 0; setae of second pair of lobes and lateres large, prominent; oracratubae in longitudinal rows; genacerores 4-5 (15-18) 7-10; anus small, over five times its width from caudal margin.—Ohio on Pinus. -----*glanduliferus* Ckll.
- bb. Pygidium with median pair of lobes contiguous and without plates in median incisura; median pair of lobes with lateral margin crenulate; plates short and inconspicuous; genacerores 4-5 (10-10) 7-8.—Japan on Quercus. -----*cryptozanthus* Ckll.

SPECIES OF DIASPIDIOTUS

- a. Pygidium always with pectinae or plates in median incisura.
- b. Pygidium with pectinae in median incisura, often minute and lacinations difficult to identify.
- c. Pygidium with median pair of lobes with distinct mesal and lateral notches.
- d. Pygidium with median pair of lobes entire, quadrangular, mesal margins oblique, convergent, mesal and lateral notches, latter deepest; two pairs of densariae; pectinae not deeply lacinate, arranged 2, 8-9, those of each lateris arranged in three groups, two associated with each second densaria, three with each third, and three or four cephalad of third densaria, two cephalic groups unapectinae; genacerores 0-8 (6-14) 5-8.—Eastern United States, Colorado, New Mexico, Washington, Germany on apple, pear, quince, cherry, peach, linden, oak, maple, beech, ash, osage orange, hackberry, currant, etc.-----*ancylus* Putn.
- dd. Pygidium with median pair of lobes with distal ends finely serrate; densariae of second incisura about equal in length. —Iowa on willow.-----*ancylus serratus* Newl. & Ckll.
- cc. Pygidium with median pair of lobes with mesal notch wanting, lateral notch frequently obtuse or nearly wanting; mesal densaria of each second incisura slightly larger than lateral; densariae of median incisura larger and more marked.—Iowa on Mountain ash. -----*ancylus latilobis* Newl.
- bb. Pygidium with plates in median incisura.
- c. Pygidium with two plates, often minute and process-like, in median incisura and with more than three pectinae cephalad of each third incisura.
- d. Pygidium with mesal margins of densariae longer than lateral; median pair of lobes quadrangular, distal end bluntly

- rounded, prominent lateral notch; pectinae with slight lacinations, arranged 2, 10 or more, those of each lateris near a lobe; dorsal oraceratubae few in number, arranged in three rows; setae as long as or longer than pectinae; mesal calles fused and distant from lateral calles, latter L-shaped; anus three times its width from caudal margin, about five times from vulva, and about eleven times from mesal calles; genacerores (4-4)4-7.—Arizona on Prosopis.-----*candidula* Ckll.
- dd. Pygidium with mesal margins of densariae not longer than lateral.
- e. Pygidium with genacerores (8-10)5-6; median pair of lobes quadrangular, rounded, lateral and mesal notches, mesal margins adjacent, divergent; margin of pygidium cephalad of each incisura produced spine-like; pectinae not deeply laciniate, plates and pectinae, arranged 2, 7, plates of median incisura short, about as long as lobes, those of each lateris in three groups, 2-3-2, two cephalic ones plates, others unapectinae.—*Aspidiotus cydoniae* Comst.—Southern States, Kansas, New Mexico, Mexico, West Indies, Ceylon, Samoa on quince, fig, palms, orange, tea-plant, cactus, *Latania*, *Jasminum*.-----*lataniae* Sign.
- ee. Pygidium with genacerores 3-7(12-15)7-11; median pair of lobes broad, prominent lateral notch, sometimes with mesal notch; densariae fused, forming semicircular thickening, those of second incisurae larger than those of third; plates of median incisura short, inconspicuous, chitinous processes, each lateris with 8-10 plates and furcapectinae; dorsal oraceratubae numerous and prominent.—Ohio on *Aesculus ohioensis* York.
- cc. Pygidium with a single plate in median incisura, three pectinae on each lateris in second incisura and two in third; median pair of lobes quadrangular, faint lateral notches, angles rounded; densariae of second incisura with mesal margins larger than lateral, third incisura with lateral margin nearly obsolete; genacerores 0-5(6-10)11-11.—Iowa, Texas, on currant.-----*hunteri* Newl.
- aa. Pygidium without pectinae or plates in median incisura.
- b. Pygidium with pectinae on each lateris.
- c. Pygidium with median pair of lobes with mesal and lateral notches, not adjacent, quadrangular, mesal margins oblique; two pairs of densariae, two unapectinae associated with each second incisura and three with third and 3-5 plates cephalad of third; lateres finely serrate; genacerores 0-4(4-9)3-7.—Ohio, Illinois, Indiana, Tennessee, Kansas, Florida, Jamaica, Europe on *Vitis*, hickory.-----*uviae* Comst.
- cc. Pygidium with median pair of lobes with lateral notch only.
- d. Pygidium with three pairs of densariae, mesal thickening of densariae of second and third incisurae only slightly longer than lateral; median pair of lobes large, quadrangular, dis-

- inct lateral notch, distal margin bluntly rounded; anus two to two and one-half times its width from caudal margin; pectinae small, furcapectinae, arranged 0, 4, those of each lateris arranged 2-2-0; dorsal oraceratubae arranged in longitudinal rows; genacerores 0-3(15-23)6-14.—Ohio on Liriodendron. -----*piceus* Sands.
- dd. Pygidium with three pairs of densariae, mesal thickening of densariae of second and third incisurae much broader and longer than the lateral, those of second incisura much larger than those of third; median pair of lobes large, quadrangular, convergent, distinct lateral notch, distal margin rounded; anus twice its width from caudal margin; each second incisura with two long furcapectinae and each third with three long plates; genacerores (11-15)7-10.—Texas on *Morus*.-----  
*mori* Herrick.
- bb. Pygidium without pectinae on each lateris, but with plates or at most with a single pectina.
- c. Pygidium with two or three pairs of densariae.
- d. Pygidium with densariae in median incisura; median pair of lobes subquadrangular, longer than broad, distal end rounded, lateral notch only; densariae of median incisura ovate in outline, those of second and third incisurae subequal, those of third incisura smaller than those of second; genacerores 0-2(5-7)3-4.—Kansas, Iowa, Georgia on *Quercus*, *Ostrya*.-----  
*osborni* Newl. & Ckll.
- dd. Pygidium never with densariae in median incisura.
- e. Pygidium with two pairs of densariae, those of mesal side of second incisurae terminating in distinct oval knob, longer than those of lateral side, those of second incisura smaller, mesal side longer than lateral; median pair of lobes quadrangular, two lateral notches, minute mesal notch, sometimes wanting; anus minute, in line with mesal densariae of second incisurae; plates inconspicuous; mesal calles fused, sometimes separate, distant from oblique lateral calles; genacerores (1-3)0-1.—Mexico on *Coursetia*.-----  
*coursetiae* Marl.
- ee. Pygidium with two pairs of densariae, those of second and third incisurae subequal in size, none of them swollen.
- f. Pygidium with median pair of lobes twice as long as width of anus, anus five times its width from caudal margin and about ten times from vulva; median pair of lobes large, prominent, bluntly rounded, distinct lateral notch, mesal margins divergent; plates short, not as long as median pair of lobes, arranged 0, 3-4, two in each second incisura and one or two in third, these sometimes lacinate; mesal calles fused, lateral calles distinct, distant from mesal; genacerores 2-2(5-9)3-7.—California on *Abies*, *Libocedrus*, *Pseudotsuga*.-----  
*earhorni* Colm.

- ff. Pygidium with median pair of lobes not or only slightly longer than width of anus.
- g. Pygidium with median pair of lobes quadrangular, close together, two distinct lateral notches, mesal wanting; plates short and inconspicuous; anus large, less than twice its own width from caudal margin; dorsal oracrerutabae numerous, confined chiefly to two irregular, double, lateral rows; calles not especially prominent, mesal calles distant from each other and from lateral calles; genacerores (3-9)3-8.—New Mexico on cottonwood.-----*popularum* Marl.
- gg. Pygidium with median pair of lobes quadrangular, single large lateral notch; plates small, arranged 0, 4-6, those of lateres arranged 2-1 to 3-1 or more, one of second group furcapectina; anus small, two or three times its own width from caudal margin; dorsal oracrerutabae fairly numerous; mesal calles fused; genacerores 0-3(9-14)6-9.—*Aspidiotus aesculi solus* Hunter.—Kansas on Juglans.-----*solus* Hunter.
- cc. Pygidium with single pair of densariae, located in second incisurae, subequal in length, if third incisurae with densariae, these very small; lobes subquadrangular, nearly as broad as long, not strongly projecting, distinct lateral notch, mesal wanting; plates small, inconspicuous, arranged 0, 3, those of each lateris arranged 1-2 in incisurae; setae about as long as or longer than lobes; lateres entire; anus five times its width from caudal margin; calles not fused, not prominent, mesal calles fused, distant from oblique lateral calles; genacerores (5-17) 4-11.—California on Aesculus. -----*aesculi* Johns.

## SPECIES OF CHRYSOMPHALUS

- a. Pygidium never with more than five pairs of paraphyses.
- b. Pygidium with three pairs of paraphyses.
- c. Pygidium with first pair of paraphyses longest, cephalic end enlarged, knob-like, second pair similar in form, shorter, third pair about one-half length of first pair, not enlarged at cephalic end; median pair of lobes longest, faint mesal and lateral notches, bluntly pointed; second, third, and fourth pairs bluntly pointed, second pair smaller than others, much nearer median lobe than third; pectinae small, obscure, arranged 2, 2, 3, 3, 0; lateres practically entire; genacerores forming almost continuous arc, 75-100 cerores.—Ceylon on *Murraya*.-----*quadriclavatus* Green.
- cc. Pygidium with first pair of paraphyses about one-half length of subequal second and third pairs, these latter enlarged at cephalic end, club-shaped; median pair of lobes subtriangular, lateral margin oblique, emarginate, serrate; second and third pairs of lobes similar to median and subequal, serrate; pectinae short, arranged 2, 2, 2, 0; each lateris serrate, bearing many

- closely placed short oracratubae; head and thorax with several long setae with tubular bases; genacerores (10-14)10-12.—Japan on Quercus. -----*setiger* Mask.
- bb. Pygidium with more than three pairs of paraphyses.
- c. Pygidium with four pairs of paraphyses, about as long as median pair of lobes.
- d. Pygidium with median pair of lobes entire, well separated, about as broad as long, rounded; second pair of lobes distant from median, distance equal to width of median lobe, broader than long, entire; third pair of lobes pointed, tooth-like, less conspicuous; each lateris with lobe-like projection; anus near cephalic ends of paraphyses; genacerores (4-4)3-3.—Mexico on orange. -----*koebelci* Ckll. & Towns.
- dd. Pygidium with median pair of lobes with mesal and lateral notches, bluntly rounded between notches; second pair of lobes similar in form, slightly smaller; third pair of lobes more irregular, conspicuous lateral notch; pectinae slightly longer than lobes, arranged 2, 2, 3, 3; each lateris adjacent to cephalic pectina with stout marginal prominence; paraphyses slender, sides subparallel; anus three times its width from caudal margin; dorsal oracratubae in two rows on each side; genacerores (3-4)2-3; vulva between pregenacerores.—Seychelles on Cocos. -----*ansei* Green.
- cc. Pygidium with five pairs of paraphyses.
- d. Pygidium with fourth pair of paraphyses not more than one-half length of third, second pair longest, first, third, and fifth long, slightly shorter than second; median pair of lobes longer than broad, bluntly rounded, prominent lateral notch; second pair of lobes smaller than median, bluntly pointed, entire; third pair of lobes smaller than second, elongate, lateral margin notched; pectinae short, arranged 2, 2, 3, 4, those of median and second incisurae distapectinae, others unapectinae; genacerores (3-4)2-3; thorax not produced on each side into a tooth.—Jamaica on mango.---*mangiferae* Ckll.
- dd. Pygidium with fourth pair of paraphyses as long or much longer than fifth.
- e. Pygidium with all paraphyses of each side very different in length.
- f. Pygidium with first pair of paraphyses shorter than others, second and fourth pairs longest, third and fifth intermediate in length; median pair of lobes rounded, deep lateral notch, mesal margins convex; second pair of lobes nearly as large as median, similar in shape, lateral notch; third pair of lobes elongate; bluntly rounded, lateral notch; pectinae large, arranged 2, 2, 3, 6-7, those of each lateris unapectinae, others distapectinae; genacerores (4-8)2-4; thorax produced on each side into a short prominent tooth-like projection.—*Chrysomphalus propositus* Banks.—India, Japan, Australia, Brazil,



Mexico, California, eastern United States, Europe, Egypt, Ceylon, Mauritius, Natal, south Africa on orange, lemon, cocoanut, banana, palms, rose, Ilex, Camellia, Dictyosperma, Phyllodendron, guava, grape-fruit, olean-der, fig, Begonia, etc. -----*aonidium* Linn.

- ff. Pygidium with first pair of paraphyses nearly as long as fourth and more than twice as long as second, third, and fifth, fourth pair very slightly longer than first; median pair of lobes slightly wider than long, distal margin transverse, subtruncated, slightly indented; second and third pairs of lobes slightly smaller, similar in form, broader than long; pectinae and plates subequal in length to lobes, arranged 2, 2, 3, 3, caudal one of each of two last groups a plate; each lateris thickened, four or five sharp tooth-like projections with serrate edges; genacerores (6-10)3-7; caudal portion of each lateral margin of thorax with tubercle, not bearing a horn.—Brazil on Laurus. -----*paulistus* Hemp.
- ee. Pygidium with all paraphyses of each side subequal in length, first pair as long as others; median pair of lobes bluntly pointed, elongate, prominent lateral notches; second pair of lobes similar to first, smaller, notched; third pair of lobes similar to second, smaller, serrate on lateral margin; pectinae elongate, arranged 2, 2, 3, 5, those of third incisurae and lateres unapectinae; genacerores (3-4) 1-3; thorax produced on each side into prominent tooth-like projection.—Italy, Jamaica, Demerara on Croton, Cycas, Pandanus, rose, mango.-----*pinnuliferus* Mask.
- aa. Pygidium always with more than five pairs of paraphyses.
- b. Pygidium with six or seven pairs of paraphyses.
- c. Pygidium with six distinct pairs of paraphyses.
- d. Pygidium with first and second pairs of paraphyses never subequal.
- e. Pygidium with second, third, fourth, and fifth pairs of paraphyses subequal, longer than first and sixth, second pair slightly longer than third, fourth, and fifth, first pair shortest, and sixth pair intermediate in length; median pair of lobes large, broad, distal margin oblique, sinuate; second pair of lobes much shorter and narrower than median pair, bluntly rounded; third pair smaller than second, more pointed; pectinae short, arranged 2, 2, 3, 3, those of median and second incisurae distapectinae, others unapectinae; genacerores (4-4)2-3.—*Chrysomphalus dictyospermi arecae* Newst.—United States, West Indies, Mexico, Brazil, Demerara, China on *Dictyospermum*, *Erythrina*, Cycas, *Latania*, palms, rose, mango, etc.—*dictyospermi* Morg.
- ee. Pygidium never with four pairs of paraphyses subequal in length.

- f. Pygidium with second and fourth pairs of paraphyses subequal in length.
- g. Pygidium with fourth and sixth pairs of paraphyses subequal, second, fourth, and sixth pairs longest, others shorter and smaller; lobes broad, low, inconspicuous; median pair twice as broad as long; second pair of lobes about or nearly as broad as first; third pair of lobes obsolete; plates scarcely visible, third incisurae with two; each lateris with depression with pair of spine-like plates, cephalad of this minutely serrate with three distant pointed prominences; genacerores (8-8)4-7.—Mexico.-----*reniformis* Ckll.
- gg. Pygidium with fourth pair of paraphyses longer than sixth, fourth and fifth pairs subequal, second pair as long as fourth, longer than first and third, fourth pair very slightly longer than subequal second and fifth, first and third pairs subequal and slightly shorter than sixth; median pair of lobes elongate, longer than broad, distinct lateral and mesal notches; second pair of lobes similar in size and shape to median, distinct lateral notch; third pair of lobes broad, bluntly pointed, lateral margin with two or three notches; pectinae deeply laciniate, arranged 2, 2, 3, 3, those of incisurae other than median and of each lateris unapectinae and longer than lobes; lateres with large tooth-like projection adjacent to pectinae; genacerores (4-5)1-2.—Australia on Acacia. -----*fodiens* Mask.
- ff. Pygidium with second and fourth pairs of paraphyses not subequal in length.
- g. Pygidium with fourth pair of paraphyses longer than sixth, fourth pair longest, second and sixth pairs subequal and two-thirds length of fourth, first and third pairs distinctly shorter than second; median pair of lobes quadrangular, broader than long, entire, truncate with rounded angles; second and third pairs of lobes shorter than median and more than twice as broad, entire, distal margins oblique; pectinae about as long as median lobes or shorter, arranged 2, 2, 3, 3; lateres with two slight indentations; metathorax with large blunt marginal tubercle, tubercles and margins of abdomen strongly chitinized; anus near middle of pygidium and vulva near middle of cephalic half; genacerores (6-8)5-6.—British Guiana on *Lecythis*.-----*umboniferus* Newst.
- gg. Pygidium with fourth pair of paraphyses distinctly shorter than sixth.
- h. Pygidium with fifth pair of paraphyses longer than sixth, second and fifth pairs longer than others, first and third pairs subequal, slightly more than one-half length of second, longer than sixth, sixth

pair nearly twice as long as fourth, shortest; three pairs of subequal lobes, lateral margins sloping and serrulate; pectinae shorter than lobes, arranged 2, 2, 3, 1; genacerores (11-17)12-14.—Japan. -----*kelloggi* Kuwn.

- hh. Pygidium with fifth and sixth pairs of paraphyses subequal, second, fifth, and sixth pairs longest, first, third, and fourth pairs subequal, much shorter than others, all enlarged at cephalic end and club-shaped; median pair of lobes broad, short, broadly rounded; second pair of lobes subequal in length, broader than median pair; third pair of lobes similar to second, broader; pectinae Y-shaped furcapectinae, arranged 1, 1, 1, 3, caudal one of each lateris not Y-shaped; genacerores (8-9)7-9.—England on *Cattleia*.-----*alienus* Newst.
- dd. Pygidium with first and second pairs of paraphyses subequal, shorter than third, fourth, fifth, and sixth pairs; median pair of lobes small, distant, nearly outline of half-circle; second pair of lobes twice as broad as median; third pair of lobes fully three times as broad as median, margin minutely serrulate; each lateris minutely serrulate with three distant notches limiting four broad projections; genacerores (8-9)6-7.—Mexico on orange. -----*albopictus* Ckll.
- cc. Pygidium with seven pairs of paraphyses, fifth rarely not as broad as others.
- d. Pygidium with fifth pair of paraphyses distinctly longer than fourth.
- e. Pygidium with fifth pair of paraphyses four times as long as fourth.
- f. Pygidium with second pair of paraphyses shorter than fifth and three times as long as first, second, fifth, and seventh pairs longest, first, third, and fourth pairs shortest, sixth intermediate; median pair of lobes short, narrow, lateral margin obliquely rounded, entire; second pair of lobes short and broad, broader than median pair, lateral margin broadly obliquely rounded, serrate; third pair of lobes short and broad, broader than second pair, lateral margins obliquely rounded, serrate; pectinae short, narrow, distapectinae, arranged 2, 2, 2, 6, those of each lateris arranged 2-1-1-1-1; genacerores (15-16)7-9.—Mexico, Central America on *Avocado* pear, *Citrus*, *Laurus*. -----*scutiformis* Ckll.
- ff. Pygidium with second pair of paraphyses as long as fifth, about twice as long as first, seventh pair distinctly shorter than fifth and longer than first, third, fourth, and sixth pairs subequal, about one-half length of first; median pair lobes short, distal end oblique on each side, bluntly rounded; second and third pairs of lobes smaller but similar; pectinae very inconspicuous; lateres serru-

- late, three or four small projections; *genacerores* (7-7) 5-5.—Mexico on mangrove. -----*rhizophorae* Ckll.
- ee. Pygidium with fifth pair of paraphyses not four times as long as fourth.
- f. Pygidium with fifth pair of paraphyses not more than twice as long as fourth, first, third, and fifth pairs subequal and longest, sixth pair slightly shorter than fifth and longer than subequal second, fourth, and seventh; median pair of lobes subquadrangular, as broad as long, distinct mesal and lateral notches, distal end bluntly rounded; second pair of lobes similar in form and size to median pair; third pair of lobes subequal in size to second pair, distal end bluntly rounded, prominent lateral notch, no mesal notch; pectinae arranged 2, 2, 3, 3, those of each lateris unapectinae; *genacerores* 1-2(5-6) 6-6.—Ceylon on unidentified tree.-----*pedronis* Green.
- ff. Pygidium with fifth pair of paraphyses longer than fourth, not twice as long, fifth pair longest, second, fourth, and seventh pairs subequal, a little shorter than fifth, first pair two-thirds length of second and one-fourth longer than third, third and sixth pairs subequal; median pair of lobes quadrangular, distinct lateral notch, as broad as long; second and third pairs of lobes similar, smaller than median, lateral margin oblique, notched; pectinae short, not as long as lobes, furcapectinae, arranged 1, 1, 1, 2; lateres toothed and serrate; *genacerores* 6-9(17-24)9-16.—South Africa on *Virgilia*, *Erythrina*, *Celastrus*, *Schinus*, *Robinia*, olive, apple, hawthorn, ket-apple, lilac, pear, poplar, plane-tree, privet, rose, peach, plum, walnut.-----*corticosis* Brain.
- dd. Pygidium with fifth pair of paraphyses not one-half length of fourth, if subequal in length, narrow and inconspicuous.
- e. Pygidium with each lateris entire, serrate, or slightly indented, but never saw-toothed.
- f. Pygidium with five or six pectinae on each lateris; paraphyses short, longest but little longer than adjacent lobes, fifth pair slender inconspicuous thickening; median pair of lobes distinctly broader and longer than second pair, quadrangular, mesal and lateral notches, broadly rounded; second pair of lobes similar but smaller; third pair of lobes bluntly triangular, short; pectinae deeply lacinate, arranged 2, 2, 3, 5-6, those of median incisura short, furcapectinae, those of other incisurae unapectinae, lacinations of those of each lateris reduced in number, particularly cephalic ones; *genacerores* (1-3)3-4.—Italy on *Camellia*.-----*degeneratus* Leon.
- ff. Pygidium with two or three pectinae on each lateris; paraphyses in three lengths, second, fourth, and seventh

pairs longest, first and third pairs shortest, fifth and sixth pairs slightly longer than latter, seventh pair very small; median pair of lobes short and narrow, rounded, entire; second pair of lobes short and broad, broader than median pair, lateral margin broadly oblique and crenulate; third pair of lobes short and broad, broader than second pair, lateral margin broadly oblique, serrate; pectinae short and narrow, distapectinae, arranged 2, 2, 2, 2, those of each lateris adjacent to third lobe; genacerores (10-11)6-7.—Florida, Mexico, England on *Persea*, *Magnolia*, *Anthurium*, *Ilex*, *cocanut-palm*.-----  
*perseae* Comst.

- ee. Pygidium with each lateris with deep indentations, appearing distinctly saw-toothed.
- f. Pygidium with fourth pair of paraphyses distinctly longer than third or fifth, never twice length of either, first pair shortest, third and fifth pairs next in length, sixth and seventh pairs next; median pair of lobes broad, broadly rounded, subquadrangular, slight mesal and lateral notches; second and third pairs of lobes similar, broader than long, lateral margin longest and strongly oblique, crenulate, subtriangular, bluntly rounded; pectinae short, narrow, distapectinae or furcapectinae, arranged 1, 1, 2, 2; each lateris with about four teeth; genacerores 3-3(8-11)5-7.—District of Columbia, Ohio, Illinois, Kansas, Florida on oak, hickory, pecan, grape. -----*obscurus* Comst.
- ff. Pygidium with fourth pair of paraphyses three times length of third and twice length of fifth, fourth and seventh pairs subequal and longest, first, third, and sixth pairs subequal and shortest, fifth pair distinctly longer than third and slightly shorter than fourth; paraphyses knob-like at cephalic end; median pair of lobes broad, broader than long, caudal margin longest; second and third pairs of lobes similar in form, wide, third pair widest; each lateris with about six tooth-like projections; pectinae present, exceedingly minute; spiracerores wanting; genacerores (6-9)3-5.—British Guiana on *Erythraspis*. -----*erythraspidis* Newst.
- bb. Pygidium with nine pairs of paraphyses.
  - c. Pygidium with third pair of paraphyses four times as long as fourth, second pair shortest, fourth, fifth, and seventh pairs slightly longer, third and sixth pairs longest, first, eighth, and ninth pairs intermediate; median pair of lobes broadly rounded, slight lateral notch; second and third pairs of lobes similar, not notched; pectinae truncate, arranged 2, 2, 2, 4, those of each lateris furcapectinae; genacerores (4-4)3-4.—New Zealand, Louisiana on *Linum*. -----*sphaertoides* Kkll.
  - cc. Pygidium with third and fourth pairs of paraphyses subequal in length.

- d. Pygidium with second, third, and fourth pairs of paraphyses subequal in length.
  - e. Pygidium with each lateris not deeply notched; paraphyses long, subequal, all much longer than lobes; median pair of lobes quadrangular, bluntly rounded, distinct mesal and lateral notches; second and third pairs of lobes similar but smaller; pectinae not deeply laciniate, arranged 2, 2, 3, 1-2, those of median incisura narrow, distapectinae, all others unapectinae; each lateris with seven tooth-like projections; genacerores (9-12)8-9, according to Brain (7-9) 3-5.—*Chrysomphalus rossi victoriae* Ckll.—Australia, New Zealand, Philippine Islands, Japan, China, Ceylon, South Africa on *Xanthorrhoea*, *Eucalyptus*, *Nerium*, *Caffaris*, *Rhinocarpus*, *Acacia*, *Araucaria*, *Abutilon*, *Artemesia*, olive, plum, etc. -----*rossi* Mask.
  - ee. Pygidium with each lateris deeply notched or "bayed in;" genacerores (9-14)7-11.—Ceylon, South Africa on *Capparis*, *Chaetachme*. -----*rossi grecni* Brain & Kelly.
- dd. Pygidium with second pair of paraphyses twice as long as either third or fourth pairs.
  - e. Pygidium with second and third pairs of lobes subequal to or narrower than median pair; median pair of lobes short and broad, lateral margin long, oblique, rounded, entire; second and third pairs of lobes similar, faintly notched; pectinae short, distapectinae, arranged 2, 2, 2, 5, those of each lateris arranged 2-1-1-1; each lateris with about six tooth-like projections; paraphyses variable in length, first, third, fourth, sixth, seventh, and ninth subequal in length, shorter than second, fifth, and eighth, fifth longest, second dilated at cephalic end; genacerores 4-8 (15-16)8-11.—Mexico on "Trueno."-----*nigropunctatus* Ckll.
  - ee. Pygidium with second and third pairs of lobes wider than median; median pair of lobes contiguous, widened; third pair of lobes subequal to second; second incisurae less than one-half width of median lobe; third incisurae equal to width of median lobe; each incisura with angular projection, cephalad of this serrate; this species is allied to *nigropunctatus*; paraphyses are not described; genacerores (13-16)8-8.—Mexico on *Agave*.-----*agavis* Towns. & Ckll.

SPECIES OF PSEUDISCHNASPIS

- a. Pygidium with six pairs of paraphyses, first and third pairs subequal, second and fifth pairs subequal and three times as long as first; fourth and sixth pairs subequal and about twice as long as first; median pair of lobes subquadrangular, broadly rounded, distal margin with two notches; second and third pairs of lobes broader than median, third broader than second, lateral margin oblique, serrate; furcapectinae arranged 1, 2, 2, 1-3; lateres thickened and toothed; genacerores (6-8)4-7.—Brazil on *Myrcia*. -----*lincais* Hemp.

- aa. Pygidium with six pairs of paraphyses, first pair slightly longer than third, second and fifth pairs subequal and longest, as long as third, fourth and sixth pairs subequal, slightly longer than third.
- b. Pygidium with three pairs of lobes, successively larger from first to third, latter with two small notches on lateral margin; each lateris with three serrations; genacerores 2.2(5.5)3.3, pregenacerores and postgenacerores of each side forming nearly continuous row.—Mexico on mango.-----*longissima* Kkll.
- bb. Pygidium with three pairs of lobes; median pair subquadrangular with rounded caudal ends, close together, entire; second and third pairs of lobes broader and larger than median, lateral margin oblique, faintly serrate; pectinae short, narrow, distapectinae, subequal in length to lobes, arranged 2, 2, 2, 5, each lateris with two pectinae adjacent third lobe and three truncate plates distributed along margin cephalad of pectinae; each lateris with five distinct serrations; genacerores (7.7)8.8.—Jamaica, Mexico on Agave. -----*bowreyi* Kkll.

## SPECIES OF LINDINGASPIS

Pygidium with three pairs of more or less unsymmetrical subequal lobes, broader than long, broadly rounded, margin finely crenulate; pectinae broad, slightly longer than lobes, lacinations deep, arranged 1, 1, 1-2, 1, one of each lateris adjacent third lobe; each lateris with six or more large, equidistant, tooth-like projections, smaller teeth between two caudal projections; spiracerores wanting; genacerores in two groups, 8-10; dorsal oraceratubae prominent, longitudinal row extending cephalad from each third incisura; paraphyses in five pairs, first and second pairs associated with median lobes, third pair with second pair of lobes, fourth pair longest and opposite third incisura, fifth pair opposite caudal margin of third pair of lobes.—*Melanaspis samoana* Lindgr.—Samoa on *Myristia*.-----*samoana* Lindgr.

## SPECIES OF FORBESASPIS

Pygidium with median pair of lobes subtriangular, converging, subadjacent, mesal portion longest, distal end bluntly rounded, lateral margin oblique, deep lateral notch; second pair of lobes small, not strongly protuberant, distinct lateral notch; densariae present between median pair of lobes, mesal side of densariae of second incisurae much larger than minute lateral, those of third incisurae subequal, fused; genacerores 0.4(3.7)3.5.—Canada, eastern United States, New Mexico, Mexico, Porto Rico, Germany, south Africa on plum, peach, pear, apple, quince, cherry, currant, gooseberry, apricot, beech, hawthorn, honeylocust, walnut, Jasmine, Acer.-----*forbesi* Johns.

## SPECIES OF FERRISPIS

Pygidium with median pair of lobes prominent, margins convex, distal end rounded, prominent lateral notch; lateres entire, second and third incisurae with densariae, mesal and lateral margins subequal, those of second much larger; dorsal oraceratubae numerous, arranged in oblique band nearly parallel with margin; setae as long as median lobes; anus

small, about five times its width from caudal margin and fifteen from vulva; genacerores 0-2(2-5)2-5; mesocalles fused and distant from latacalles.—Arizona on Covillea. -----*covilleae* Ferris.

SPECIES OF CONSTOCKIELLA

- a. Pygidium with six groups of genacerores.
  - b. Pygidium with genacerores 4-6(4-7)7-15; caudal margin deeply and roundly notched at meson, pair of short setae in notch; each lateris with five long setae and three short ventral setae located just within margin; four dorsal oraceratubae in front of notch in two rows, two or three rows extending length of pygidium on each side of anus; anus located five times its width from caudal margin and about one-half its width cephalad of vulva.—Florida, Guadalupe Island on Erythea, palmetto.-----*sabalis* Comst.
  - bb. Pygidium with genacerores 11-15(7-10)14-17.—Mexico on palms.---  
*sabalis mexicana* Ckll.
- aa. Pygidium with five groups of genacerores; margin with lobes little developed, represented by three pairs of broad low rounded prominences, all wide apart, incisurae and especially lateres irregular with more or less angular prominences; sides of caudal part of insect finely transversely striate; setae and pectinae or plates not noticeable; paraphyses and densariae wanting; dorsal oraceratubae many, row of transverse ones; genacerores 5-6(21-22)22-23; scale long, oval, moderately convex, rough, grayish brown.—Chile on Chisquoa.—This like the type species has many characteristics of the *Diaspidini*.----  
*viverae* Ckll.

SPECIES OF LIGULASPIS

Pygidium with three groups of genacerores, sometimes almost united into single group, mesogenacerores 27, latagenacerores 106; pygidial margin with five plate-like projections, mesal longest, narrowest, three-lobed, others irregularly notched and toothed; lateral margin of two caudal segments of preabdomen chitinized and plate-like; oraceratubae numerous on pygidium and segments of body; anus located just caudad of mesogenacerores; mesospiracerores and metaspiracerores 36.—*Odonaspis janeirensis* Hemp.—Brazil on grass.-----*janeirensis* Hemp.

SPECIES OF ODONASPIS

Pygidium with single fused median lobe with prominent lateral notches, other lobes obsolete; each lateris with four prominent indentations from which longitudinal thickenings extend, indentations limited by angular teeth on cephalic side, serrate between indentations; genacerores in two converging groups, each consisting of 80-90; mesospiracerores and metaspiracerores less than 10; anus nearer vulva than caudal margin.—*Odonaspis secreta* saccharicaulis Zehnt., *Odonaspis secreta greeni* Ckll.—Japan, Hawaiian Islands, Java, Ceylon on bamboo, *Arundinaria*. -----*secreta* Ckll.

SPECIES OF BERLESASPIDIOTUS

Pygidium without lobes, plates, or pectinae; no mesal indentation, in-



dentation at caudal end of second pair of paraphyses; lateres with two deep notches; two pairs of equidistant paraphyses; anus located near vulva, distant from caudal margin, near mesogenacerores; genacerores in three groups, mesogenacerores 50 and latagenacerores 150.—*Odonaspis* (*Anoplaspis*) *bambusarum* Ckll.—Japan, California on bamboo.—*bambusarum* Ckll.

## SPECIES OF NEOSIGNORETIA

- a. Pygidium without pectinae or plates on lateres.
- b. Pygidium with three pairs of lobes.
- c. Pygidium with median pair of lobes notched.
  - d. Pygidium with plates in median incisura; median pair of lobes wide, others rudimentary, all small; plates long and slender, sharp, conspicuous, distinctly longer than lobes, arranged 2, 1, 1, 0; anus located near caudal margin.—The reference of this species to *Pseudodiaspis* needs confirmation.—*Targionia yuccae neomexicana* Ckll.—Mexico on *Yucca*.—*yuccae* Ckll.
  - dd. Pygidium without plates or pectinae in median incisura; median pair of lobes short, subquadrangular, deep lateral notch; second and third pairs of lobes rudimentary, second pair larger and with lateral notch; plates and pectinae about as long as median lobes, arranged 0, 2, 2, 0, mesal projection of second and third incisurae a plate and lateral pectina; setae about as long as median lobe; dorsal oraceratubae prominent, not numerous; anus small, distant four or five times its width from caudal margin.—California on *Quercus*.—*yulupae* Bremner.
- cc. Pygidium with median pair of lobes entire, short, truncate or bluntly rounded; second pair of lobes broader than median, short, broadly rounded, entire; third pair of lobes represented by stout marginal prominence; median incisura about as wide as median lobe, with two short blunt plates, not longer than lobes, second incisura with two similar plates; dorsal oraceratubae small and inconspicuous; anus three times its width from caudal margin; scale of adult female snowy white, strongly convex.—Australia on *Styphelia*.—*immaculata* Green.
- bb. Pygidium with four pairs of lobes; median pair of lobes small, moderately prominent, constricted at proximal end, hatchet-shaped, lateral and distal margins forming continuous curve; second, third, and fourth pairs of lobes simply marginal prominences, angular; plates or pectinae of median and second incisurae not longer than median lobes, of fourth incisurae longer, arranged 2, 2, 3, 4, 0, those of median, second, and third incisurae plates, others pectinae; anus minute, ten times its width from caudal margin and over twenty times from vulva; dorsal oraceratubae in two longitudinal rows; second and third incisurae with two pairs each of minute thickenings; calles present and separate.—Northern Australia on *Eucalyptus*.—*miniatae* Green.
- aa. Pygidium always with pectinae or plates on lateres.

- b. Pygidium with median pair of lobes with lateral notches.
- c. Pygidium with median pair of lobes with mesal and lateral notches.
  - d. Body with margin of cephalic end entire, not finely crenulate; pygidium with median pair of lobes quadrangular, deep lateral and mesal notches; second pair of lobes spatulate, bluntly pointed or bluntly rounded, entire or with faint lateral notch; third pair of lobes spatulate, subequal to second pair, bluntly rounded, entire or with faint lateral notch; pectinae long and narrow, subequal in length to lobes, arranged 2, 2, 3, 8, those of each lateris unapectinae and shorter than others, placed cephalad of third lobe; caudal pectina of each third incisura much smaller than other two. —South Africa on Euphorbia. -----*tectaria* Lindgr.
  - dd. Body with margin of cephalic end finely crenulate; pygidium with median pair of lobes quadrangular, deep mesal and lateral notches, distal margin rounded between them; second pair of lobes broader than long, lateral margin oblique, deep lateral notch, mesal portion projecting; third pair of lobes narrower, deep lateral notch, projecting mesal portion more angular; distapectinae in median incisura, others unapectinae, latter longer than lobes, arranged 2, 2, 3, 3; spiracerores wanting; anus about twice its width from caudal margin; vulva located near cephalic half of pygidium. —Gymnaspis africana Newst. —Uganda, Africa. -----*africana* Newst.
  - cc. Pygidium with median pair of lobes with distinct lateral notches only, projecting, distinct, about as broad as long, distal end bluntly rounded; second pair of lobes smaller, triangular, bluntly pointed; third pair of lobes minute, pointed; pectinae minute, short, narrow, lacinations minute, arranged 2, 2, 2, 1, those of second and third incisurae and of each lateris unapectinae; anus distant three or four times its width from caudal margin. —Sardinia, Italy on Osirys. -----*cecconi* Leon.
  - bb. Pygidium with median pair of lobes entire, large, broadly bluntly rounded, distant; second and third pairs of lobes minute, subtriangular, more or less pointed; pectinae arranged 2, 2, 2, 5, those of incisurae and three caudal ones of each lateris very broad, deeply lacinate at distal end, cephalic two of each lateris slender, unapectinae with short blunt branches; pectinae of each lateris adjacent third lobe; setae limited to two on each lateris near cephalic pectinae; center of pygidium cephalad of anus with large tongue-shaped strongly chitinized area; anus distant two or three times its width from caudal margin. —Uganda, Africa on Anona. *gowdeyi* Newst.

SPECIES OF TOLLASPIDIOTUS

- a. Pygidium with two plates in each third incisura; median pair of lobes subquadrangular, distal end and angles broadly rounded, as broad as long, entire; second and third pairs of lobes similar in size and form; plates subequal in length to lobes, arranged 2, 2, 2, 0;

each lateris irregularly toothed; anus located midway between vulva and caudal margin, vulva located at cephalic end of pygidium; mesospiracerores 5-6; preabdomen with lateral margins of segments produced, tuberculate; each bearing few setae; scale subcircular, exuviae central, caudal end elevated by ventral scale.—*Mauritius* on palm trees. -----*mauritanus* Newst.

- aa. Pygidium with three plates in each third incisura; median pair of lobes spatulate, proximal portion constricted, distal end bluntly rounded, longer than broad; second and third pairs of lobes similar in form and size; plates subequal in length to lobes, arranged 2, 2, 3, 0; each lateris with five large lobe-like unsymmetrical projections with serrate margins cephalad of third lobe; setae of lateres very long and slender, much longer than lobes, others minute.—*Furcaspis rufa* Lindgr.—Island of Reunion, St. Denis on *Erythroxylon*. -----*rufus* Lindgr.

#### SPECIES OF CRYPTASPIDIOTUS

Pygidium with median pair of lobes large, broader than long, entire, broadly truncately rounded; second pair of lobes smaller, narrower, entire, truncately rounded; pectinae subequal in length to lobes, arranged 2, 2, 3, distapectinae; anus apparently distant from caudal margin; spiracerores wanting; lateres crenulate.—Algeria on *Juniperus*, *Callitris*. -----*mediterraneus* Lindgr.

#### SPECIES OF MORGANELLA

Pygidium with pectinae on each lateris; anus located near proximal ends of lobes; median pair of lobes long, longer than broad, pointed, adjacent, deep lateral notch; pectinae broad unapectinae, small or long adjacent to median lobes, successively broader cephalad, much longer than lobes, sometimes arranged in three groups, arranged 0, 13; setae adjacent to median lobes shorter than lobes, others much longer than pectinae.—*Morganella maskelli* Ckll.—Brazil, Hawaiian Islands, Mauritius, Ceylon, south Africa, Demerara on *Michelia*, *Camellia*, *Artocarpus*, *Cupania*, *Lagerstromia*, mango, orange, papaw.-----*longispina* Morg.

#### SPECIES OF PSEUDOTARGIONIA

Pygidium with median pair of lobes entire, distant, truncate with rounded angles, longer than wide; second pair of lobes adjacent to median, smaller, distinct lateral notch on distal end, bluntly rounded; third pair of lobes rudimentary; plates not prominent, arranged 0, 0, 2-3, 0, irregular in length; lateres thickened, crenulate, bearing 5-6 setae, twice as long as median lobes; dorsal oraceratubae in three rows on each side; anus adjacent to median pair of lobes; mesal part of dorsal surface of pygidium between dorsal oraceratubae distinctly thickened; spiracerores 5-6, large; head and thorax with 8-10 long slender setae.—*Aonidia glandulosa* Newst.—Upper Egypt on *Acacia*.-----*glandulosa* Newst.

#### SPECIES OF CRENULASPIDIOTUS

Pygidium with median pair of lobes subquadrangular, not strongly projecting, mesal and lateral margins parallel, distal margin crenulate;

second pair of lobes bluntly rounded, crenulate; third and fourth pairs of lobes bluntly pointed, crenulate; plates arranged 2, 2, 3, 3, 3, those of second incisurae described as single deeply divided plate, those of median incisura similarly described and more than twice as long as lobes, all other plates short; anus very distant from caudal margin.—Venezuela on *Bletia*. -----*portoricensis* Lindgr.

SPECIES OF SEPARASPIS

*Pygidium* with median pair of lobes twice as long as wide, entire, distal end bluntly rounded, sides parallel; second, third, and fourth pairs of lobes similar in form and subequal in size to median pair, entire; plates subequal in length to lobes, distal ends blunt, arranged 2, 2, 3, 0; each lateris with four adjacent, entire, lobe-like projections, caudal one largest, others successively smaller; dorsal oracratubae few in number; anus distant from caudal margin.—Transvaal, Africa on *Protea*, Faurea. -----*protea* Brain.

SPECIES OF BRAINASPIS

*Pygidium* with median pair of lobes small, quadrangular, mesal and lateral notches, about as broad as long; second pair of lobes large, much longer and broader than median pair, elongate, longer than broad, rounded, entire; third pair of lobes smaller than median, triangular, bluntly rounded, faint lateral notch; pectinae distinctly laciniate, arranged 2, 2, 2, 2, those of median and second incisurae longer than median lobes, distinctly shorter than second pair of lobes, those of third incisurae as long as second pair, those of each lateris as long as third pair; anus distant from caudal margin; spiracerorres wanting.—South Africa on *Andropogon*. -----*kellyi* Brain.

SPECIES OF CRYPTOPHYLLASPIS

- a. *Pygidium* with four or five unapectinae on each lateris.
  - b. *Pygidium* with margin of each second and third incisura produced into short prominent point; median pair of lobes larger than others, constricted toward proximal end, mesal and lateral notches; second and third pairs of lobes elongate, bluntly pointed, third pair usually with a lateral notch; pectinae deeply laciniate, arranged 2, 2, 3, 4-5; oracratubae numerous, tendency to arrange themselves in transverse rows; insects forming and occupying small pits on underside of leaves.—Ceylon on *Strobilanthes*.---*putearia* Green.
  - bb. *Pygidium* with margin of each second and third incisura concave, not produced.
  - c. *Pygidium* with proximal portion not constricted, lateral margins uniformly gradually converging toward caudal end; median pair of lobes much larger than others, long and prominent, mesal and lateral notches; second and third pair of lobes bluntly pointed, elongate, lateral notches; pectinae deeply laciniate, arranged 2, 2, 3, 4-5; oracratubae few in number, not arranged in transverse rows; insects forming galls upon upper surface of leaves.—Ceylon on *Grewia*. -----*occulta* Green.

- cc. Pygidium with cephalic portion abruptly constricted so that subparallel lateral margins of portion caudad of constriction meet cephalic portion at an angle; pectinae and lobes like those of occultus; oraceratubae few in number; pectinae long and deeply laciniate; insects forming cylindrical galls twice as long as wide, constricted at base, ends often studded with irregular tubercles, upon lower surface of leaf.—*Aspidiotus* (*Cryptophyllaspis*) *occultus elongatus* Green.—Ceylon on *Grewea*.-----*elongata* Green.
- aa. Pygidium with three pectinae on each lateris.
- b. Pygidium with three deeply laciniate furcapectinae on each lateris; median pair of lobes with slight mesal and lateral notches; three pairs of lobes not darkened; pectinae narrow and strongly fringed, each lateris with three double pectinae each having appearance of two squames (plates?) joined at proximal end; incisurae with densariae; dorsal oraceratubae not numerous, arranged in two rows on each side; setae small.—Bismarck Archipelago on *Codiaeum*.-----*rubsamini* Kell.
- bb. Pygidium with three deeply laciniate unapectinae on each lateris; median pair of lobes elongate, deep mesal and lateral notches, distal margin bluntly pointed; second pair of lobes much smaller, unsymmetrical, oblique, margin with deep lateral notch or crenulate; third pair of lobes irregular, pointed, notched; pectinae deeply laciniate, much longer than median pair of lobes, arranged 2, 2, 3, 3-5; dorsal oraceratubae distinct; insects forming small conical galls on leaves.—Canary Islands, Madeira on *Globularia*.---*bornmulleri* Rùbs.

## SPECIES OF SPINASPIDIOTUS

- a. Body with cephalic margin entire, not thickened and regularly crenulate.
- b. Pygidium with median pair of lobes distinctly notched.
- c. Pygidium with five to seven pectinae on each lateris.
- d. Pygidium with second pair of lobes distinctly shorter than median pair.
- e. Pygidium with median pair of lobes quadrangular, longer than broad, distal end truncately rounded, mesal and lateral notches; second pair of lobes much smaller, elongate, pointed, lateral notch; third pair of lobes much smaller than second, pointed, triangular, lateral margin toothed; pectinae long, narrow, subequal in length to median lobes, deeply laciniate, arranged 2, 2, 3, 6-7, those of each lateris adjacent to third lobe.—South Africa on *Parinarium*, *Strychnos*.-----*fissidens* Lindgr.
- ee. Pygidium with median pair of lobes shorter than in type, second pair broader, third pair of lobes broader, short, pointed, entire or with more teeth on oblique margin toward distal end; pectinae with finer lacinations.—German East Africa, Mozambique on *Bosqueia*, *Sideroxylon*, *Chrysophyllum*.-----*fissidens pluridentatus* Lindgr.

- dd. Pygidium with second pair of lobes as long as or longer than median pair, subequal in width, similar in shape, lateral notch; median pair of lobes large, conspicuous, close together, mesal and lateral margins nearly parallel, distal margin rounded, slight lateral notch; third pair of lobes about one-half size of second pair, subsimilar in shape; pectinae subequal in length to lobes, arranged 2, 2, 3, 5-6, three caudal pectinae of each lateris deeply laciniate, others simple; dorsal oracratubae present, promiscuously arranged; usually wanting, sometimes with a single ceroris on each side; anus six times its width from caudal margin and twice its width caudad of vulva.—Samoan Islands on cocoanut husks.-----  
*pangoenensis* Doane & Ferris.
- cc. Pygidium with three pectinae on each lateris; median pair of lobes prominent, distinct lateral notch, mesal notch wanting, distal end bluntly rounded; second pair of lobes smaller, irregular, pointed, lateral notch; third pair of lobes small, triangular, pointed; pectinae subequal in length to lobes, arranged 2, 2, 3, 3, all except those of median incisura broad, irregularly laciniate; each lateris crenulate, bearing two minute plates or furcapectinae.—Dutch East Africa on *Furcraea*.-----  
*furcraeicola* Lindgr.
- bb. Pygidium with median pair of lobes entire.
- c. Pygidium with pectinae or plates on each lateris.
- d. Pygidium with third pair of lobes distinctly smaller than median pair.
  - e. Pygidium with median pair of lobes quadrangular, short, much broader than long, entire, truncately rounded; second pair of lobes minute, as long as broad, entire, bluntly rounded; third pair of lobes minute, sharply pointed, longer than broad; pectinae broad, distinctly longer than median pair of lobes, numerous deep lacinations, arranged 2, 2, 3, 4, those of each lateris adjacent to a third lobe, lacinations deeper and teeth much longer than those of other pectinae.—Abyssinia on *Euphorbia*.----*fissus* Lindgr.
  - ee. Pygidium with median pair of lobes large, longer than broad, projecting, parallel, unsymmetrical, entire, distal end broadly rounded; second pair of lobes almost as broad as long, oblique, rounded, margin with several notches; third pair of lobes similar to second, smaller; pectina or plates subequal in length to median pair, dagger-shaped plates or furcapectinae, arranged 2, 2, 3, 3.—Sardina, Spain on *Ephedra*.-----*ephedrarum* Lindgr.
- dd. Pygidium with three pairs of lobes subequal, similar in shape, entire or finely crenulate, slightly constricted on proximal portion; pectinae subequal in length to lobes, arranged 2, 2, 3, 3, those of incisurae subequal in width, distapectinae, those of each lateris toothed lobe-like projections; lateres with several angular or tooth-like projections; setae except cephalic one of each side, subequal in length to lobes,

cephalic setae two or three times length of others; surface of pygidium coarsely and irregularly reticulate; anus located considerably cephalad of middle of pygidium; scale of adult female coarsely transversely striate, exuviae lateral.—South-West Africa. -----*reticulatus* Newst.

- cc. Pygidium without pectinae or plates on lateres.
- d. Pygidium with median pair of lobes broader than long.
- e. Pygidium with pectinae tridentate, arranged 2, 2, 3, 0, those of incisurae broad, truncate, not deeply laciniate, subequal in length to lobes; median pair of lobes quadrangular, broader than long, entire, truncate with rounded angles; second pair of lobes similar to median, subequal in size; third pair of lobes similar to second, broader than long, shorter than second, truncate; lateres broadly indented and crenulate.—*Furcasplis oceanica* Lindgr.—Jaluit Islands on fruit hulls of Cocos.----*oceanicus* Lindgr.
- ee. Pectinae bidentate; median pair of lobes broader than long, entire, roundly truncate; second pair of lobes subequal to median, similar in form; third pair of lobes similar in form to second, much smaller; pectinae subequal in length to lobes, not deeply laciniate, bidentate, arranged 2, 2, 3, 0; lateres with two prominent teeth, irregular projections between third lobe and caudal tooth, three oblique projections between two teeth, oblique margin serrate.—*Furcasplis haematochroa* Ckll.—Batbatan Island. Philippine Islands on cocoanut palms.-----*haematochrous* Ckll.
- dd. Pygidium with median pair of lobes longer than broad, truncate, entire; second pair of lobes similar to median, broader; third pair of lobes broader than long, truncate, expanded at proximal end; pectinae slightly shorter than lobes, truncate, not deeply laciniate, arranged 2, 2, 2, 0; lateres indented, irregularly produced with irregular projections.—*Aspidiotus cladii* Charmoy.—Mauritius on palms.-----*charmoyi* Brain.
- aa. Body with cephalic margin thickened and regularly crenulate; pygidium with median pair of lobes large, quadrangular, distal end rounded, deep lateral and mesal notches; second pair of lobes longest on mesal margin, bluntly pointed, broad lateral notch; third pair of lobes as long as second, narrower, pointed, faint notches; pectinae long, narrow, deeply laciniate, subequal in length or slightly longer than median, arranged 2, 2, 3, 4, projections of each lateris with short bluntly truncated, evenly distributed plates.—South Africa on *Dichapetalum*. -----*macandrius* Lindgr.

#### SPECIES OF RHIZASPIDIOTUS

Pygidium with median pair of lobes almost contiguous at distal end, proximal ends distant, subtruncate, distal end notched, concave or almost truncate and broadly rounded on lateral margin, proximal portion of lateral margin notched; second and third pairs of lobes small, incised, each portion tooth-like projection; lateres crenulate or notched;

second incisurae broad; plates shorter than second pair of lobes, arranged 0, 2, 2, 0; setae small; oraceratubae small, numerous; anus longer than broad, six times its width from caudal margin.—Kansas on roots of *Helianthus*.-----*helianthi* Parrott.

SPECIES OF TRUNCASPIDIOTUS

*Pygidium* of adult female with three pairs of lobes, similar in size, stout, prominent, truncately rounded, entire; some of lobes sometimes missing; pectinae broadly truncated, without pectinations, arranged 2, 2, 3, 0, resembling lobes; each lateris thickened and coarsely dentate; paraphyses wanting; dorsal oraceratubae few in number; ventral aspect of preabdomen on each side with four to six short, stout, conical setae inserted in calices with thickened rims; head and thorax on each side with row of long stout submarginal setae.—Algoa Bay, Cape Colony, Transvaal, Africa on *Aloe*.-----*capensis* Walker.

SPECIES OF VARICASPIS

Scale of adult female elongate, sides compressed, meson rather sharply keeled, exuviae central, superimposed, secretory portion broad, attached to edge of leaf with equal portions on each side; body with dorsum strongly convex, venter flat; rostrum located nearly midway between cephalic end of body and caudal end of preabdomen, far caudad of cephalic margin; body densely chitinized except pygidium; pygidium with median pair of lobes quadrangular, distinct mesal and lateral notches, as broad as long, bluntly rounded between notches; second pair of lobes smaller than median, longer than broad, distinct lateral notch; third pair of lobes minute, distinct, lateral notch; pectinae or plates subequal in length to lobes, arranged 2, 2, 3, 3-4, one next to third lobe a pectina, others plates; vulva located near middle of pygidium and anus almost half way between vulva and caudal margin.—Uganda, Africa on *Coffea*.-----*florincides* Newst.

SPECIES OF GONASPIDIOTUS

- a. Body with cephalic margin entire and never uniformly crenulate.
- b. *Pygidium* with two pectinae or plates in median incisura.
  - c. *Pygidium* with pectina on each lateris, median pair of lobes with mesal and lateral notches, subquadrangular, prominent, broadly rounded; second pair of lobes about one-half size of median, bluntly pointed between mesal and lateral notches; pectinae subequal in length to lobes, narrow distapectinae, arranged 2, 2, 3; each lateris with three spine-like projections equidistant from each other and a second lobe, one adjacent to pectinae of lateres.—Italy on *Quercus*.-----*minimus* Leon.
  - cc. *Pygidium* without pectinae or plates on lateres.
  - d. *Pygidium* with setae small, subequal in length to median pair of lobes; median pair of lobes broader than long, mesal margins parallel, distal end bluntly rounded, lateral margin oblique, lateral notch; second pair of lobes similar to median, smaller, lateral notch; second incisurae normal in width, plates arranged 2, 2, 0, short, much shorter than



- lobes; each lateris with five rounded undulations; marginal ceratubae prominent; anus five times its width from caudal margin and three times from vulva.—California on *Cupressus*, *Sequoia*. ----- *shastae* Colm.
- dd. Pygidium with setae large, longer than median pair of lobes, four on each side; median pair of lobes with lateral notches only, rarely with mesal notch, subquadrangular, parallel or somewhat convergent, longer than broad, symmetrically bluntly rounded; second pair of lobes two-thirds size of median, subadjacent to median, oblique, broadly rounded, deep lateral notches; plates arranged 2, 1-2, 0, those of median incisura small, dagger-shaped, two, those of second incisura sometimes furcapectinae, one to two; setae large, longer than median lobes, four on each side.—Madeira on *Laurus*. ----- *laurinus* Lindgr.
- bb. Pygidium without plates in median incisura, plates in second incisurae, and pectinae on lateres, arranged 0, 2, 2; median pair of lobes large, prominent, rounded, crenulate; second pair of lobes small, nearly as broad as median, mesal margin straight, lateral margin oblique, crenulate, lobes inconspicuous; dorsal oracratubae arranged in four indefinite rows on each side; anus five times its width from caudal margin and same distance from vulva; lateres entire; setae small; mesal calles separate, distance between them subequal to distance between each mesal and lateral callis, latter oblique.—Targionia *graminellus* Ckll.—New Mexico, Colorado on ?*Hilaria*, *Bouteloua*. ----- *graminellus* Ckll.
- aa. Body with cephalic margin thickened and uniformly crenulate; pygidium with median pair of lobes quadrangular, broad with deep lateral and mesal notches, distal margin bluntly rounded; second pair of lobes much smaller, pointed, large lateral notch; pectinae subequal in length to median lobes, deeply laciniate, arranged 2, 2, 10-11, each lateris with three pectinae adjacent to second lobe and 7-8 short bluntly truncated plates distributed along margin of lateris. —This species is similar to *Spinaspidiotus maeandrius* Lindgr.—South Africa on *Acacia*, *Strychnos*. ----- *undulatus* Lindgr.

## SPECIES OF PARANEWSTEADIA

- Pygidium with two pairs of lobes, median pair minute, rounded; second pair of lobes three times as long as median pair, slightly constricted at proximal end, spatulate, lateral notch; pectinae and plates present, arranged 0, 2, 7-8, those of each lateris consisting of two long simple spatulate plates and 5-6 unapectinae, second incisura with plates.—Africa. ----- *maculata* Newst.

## SPECIES OF CHORIZASPIDIOTUS

- a. Pygidium with median pair of lobes entire; quadrangular, truncate; second and third pairs of lobes represented by slight deeply emarginate projections, producing a crenulate appearance; plates and pectinae wanting in median incisura and on lateres, arranged 0, 2, 0.—New Mexico on *Gutierrezia*. ----- *gutierreziae* Ckll. & Parr.
- aa. Pygidium with median pair of lobes notched.

- b. Pygidium with seven or eight or more pectinae or plates on each lateris.
- c. Pygidium with plates on lateres.
  - d. Pygidium with median pair of lobes with prominent mesal and lateral notches, quadrangular; plates wanting in median incisura, arranged in two groups of six each just cephalad of each median lobe, separated by small marginal prominence; each lateris cephalad of median lobe thickened for short distance, irregularly coarsely crenulate; anus distant from caudal margin; spiracerops wanting.—Ceylon from galls of *Amorphococcus mesuae*.-----*culculus* Green.
  - dd. Pygidium with each median lobe only with prominent lateral notch.
    - e. Pygidium with pectinae and plates of lateres one-fourth longer than lobes; median pair of lobes subquadrangular, prominent, projecting, longer than broad, adjacent, lateral margin straight to convex, prominent lateral notches only, one or two; each lateris with 5-7 plates, very long, much longer than lobes, curved, located adjacent to lobes in positions for incisurae on lateres; setae long and slender, as long as plates; anus large, slightly over twice its width from caudal margin and about three times from vulva; incisurae may have densariae.—*Diaspis* (*Epidiaspis*) *conspicua* Brain.—South Africa on *Acacia*, *Gardenia*, *privet*...  
*conspicua* Brain.
    - ee. Pygidium with pectinae or plates of lateres subequal to or shorter than lobes, usually with plates, at most furcapectinae; anus four times its width from proximal ends of lobes; median pair of lobes quadrangular, mesal margins adjacent, prominent lateral and faint distal notches; plates all shorter than lobes, stout, some rarely furcate, placed adjacent to lobes; setae slightly longer than lobes, five on each side; callus distinct.—*Targionia celtis* Herrick.-----*cueroensis* Ckll.
  - cc. Pygidium with pectinae on each lateris; median pair of lobes large, subquadrangular, longer than wide, single mesal and two or more lateral notches; each lateris with eight to ten furcapectinae and plates intermixed, very long and slender, some longer than lobes, located adjacent to lobe; lateres finely serrate cephalad of pectinae; setae of two lengths, one lot long, nearly as long as lobes, other lot minute, not projecting beyond margin.—South Africa on *Euphorbia*.-----*spiniger* Lindgr.
- b. Pygidium with three or four pectinae or plates on each lateris.
  - c. Pygidium with anus ten times its width from caudal margin; vulva more distant from anus than anus from caudal margin; median pair of lobes subquadrangular, slight lateral notch, distal end angular, as broad as long, prominent, projecting; pectinae shorter than median pair of lobes, three on each lateris, latapectinae, wanting in median incisura; setae as long

as lobes; dorsal oraceratubae few, not in longitudinal rows.—Australia on Casuarina. ----- *bidens* Green.

- cc. Pygidium with anus four times its width from caudal margin; median pair of lobes large, elongate, convergent, lateral margin oblique, two deep notches; plates, rarely furcapectinae, six on each lateris, arranged in two or three groups of two plates each, one near each median lobe, two short distance cephalad, third still farther cephalad, wanting in median incisura; lateres crenulate; setae long and stout, as long as or longer than lobes.—Canary Islands on *Argyranthemum*.-----  
*canariensis* Lindgr.

#### SPECIES OF REMOTASPIDIOTUS

- a. Pygidium with median pair of lobes short, not projecting much beyond general contour of pygidial margin, close together, distal ends practically contiguous, broad and obliquely truncate; pectinae apparently wanting, two minute plates adjacent to lobe; each lateris bluntly serrulate, small projection near lobe, four much larger prominent ones at considerable distance cephalad of caudal projection; anus oval, about six times its width from caudal margin and four times from vulva; surface striate with rows of small round dorsal oraceratubae.—French Bay, Bruce Peninsula, Shores of Lake Huron, Canada on *Arctostaphylos* and California on *Grindelia*, *Eriophyllum*, *Corethrogyne*. ----- *dcarnessi* Kchl.
- aa. Pygidium with median pair of lobes short, not projecting beyond general contour of pygidial margin, contiguous, distal ends oblique with mesal angle produced; second and third pairs of lobes wanting; each lateris serrate with two inconspicuous rounded projections located cephalad where a lobe would be expected; plates limited to two, short but easily distinguished just cephalad of each median lobe; setae normal; anal opening large, four times its width from caudal margin; dorsal surface striate with rows of oraceratubae, much less conspicuous than in preceding species.—New South Wales on *Chenopodium*. ----- *chenopodii* Marl.

#### SPECIES OF CHENTRASPIDIS

Pygidium with median pair of lobes fused into single rectangular lobe, twice as broad as long, margin notched; pectinae of each lateris arranged in three groups near lobe, arranged 2-2-1, separated by indentations, unapectinae; setae stout, nearly as long as pectinae; each lateris cephalad of pectinae finely striate or undulate.—Australia on *Acacia*. ----- *unilobus* Mask.

#### SPECIES OF HEMIBERLESIA

- a. Pygidium with pectinae or plates in median incisura.
- b. Pygidium with pectinae or plates on each lateris.
- c. Pygidium never with more than four, usually two or three, pectinae or plates on each lateris.
- d. Pygidium with unapectinae on each lateris.

- e. Pygidium with densariae of second and third incisurae subequal; median pair of lobes large, quadrangular, mesal and lateral notches, distant, distal margin bluntly rounded; second pair of lobes small, spear-shaped, often with lateral notch; third pair of lobes narrow, spiniform, pointed, entire; pectinae slightly larger than lobes, long slender unapectinae, arranged 2, 2, 3, 3-4; anus about its width from proximal ends of lobes.—South Africa.-----  
*mitchelli* Marl.
- ee. Pygidium with densariae of second and third incisurae not subequal; median pair of lobes large, quadrangular, distinct mesal and lateral notches, distal margin rounded between notches; second and third pairs of lobes small, triangular, attenuate at distal end, pointed; pectinae longer than median pair of lobes, arranged 2, 2, 3, 3, those cephalad of each median lobe longer and broader, deeply lacinate, unapectinae; densariae large, prominent, mesal margin of third incisurae larger than lateral; setae long; each lateris near middle with two tooth-like projections; anus over twice its width from caudal margin; spiracerotes wanting.—Mansa, Africa on Trichilia. -----*elegans* Lindgr.
- dd. Pygidium with plates or furcapectinae on each lateris.
- e. Pygidium with median pair of lobes large and well developed.
- f. Anus from one to one and one-half times its width distant from caudal margin.
- g. Pygidium with median pair of lobes with mesal and lateral notches or sinuate, quadrangular, projecting, mesal margins parallel or slightly convergent, lateral margins straight or curved; second and third pairs of lobes minute, bluntly pointed, entire; pectinae irregular, pectinae and plates arranged 2, 2, 3, 2-3, those of median incisurae furcapectinae and of other incisurae unapectinae, each lateris with plates or furcapectinae; anus one and one-half times its width from caudal margin and over five times its width from vulva; lateral and mesal margins of densariae subequal; calles all separate. — *Aspidiotus rapax* Comst., *Aspidiotus euonymi* Targ., *Aspidiotus lucumae* Kll. — United States, Mexico, West Indies, Brazil, Europe, Hawaiian Islands, South Africa, Australia, New Zealand, Ceylon on *Camellia*, *Fuchsia*, *Eucalyptus*, *Acacia*, *Myoparum*, *Thamnus*, *Cercis*, *Coprosoma*, cottonwood, walnut, willow, maple, birch, holly, laurel, olive, fig, almond, orange, lemon, apple, pear, quince, tea, etc. -----*camelliae* Sign.
- gg. Pygidium with median pair of lobes with lateral notch only, lobes prominent, projecting, distal end bluntly rounded, mesal margins straight, subadjacent;

second pair of lobes minute, bluntly pointed, entire; third pair of lobes smaller than second, pointed, pectinae and plates subequal in length to median pair of lobes, arranged 2, 2, 3, 2-3, those of median incisura and each lateris slender plates, those of second and third incisurae longest, furcapectinae; densariae of second incisurae larger than those of third, wanting in median; anus large, about its own width from caudal margin.—Argentina on *Ophryoporus*.-----

*argentina* Leon.

- ff. Pygidium with anus large, over three times its width from caudal margin; median pair of lobes large, quadrangular, deep lateral and mesal notches, distal margin strongly convexly rounded between notches; second pair of lobes small, rounded, inconspicuous; third pair of lobes rounded, smaller than second pair, inconspicuous; pectinae not deeply laciniate, about as long as median pair of lobes, arranged 2, 2, 3, 2-3, those of third incisurae and of lateres either not deeply laciniate or plates, one of each third incisura much larger than others; densariae prominent, those of second incisurae larger than those of third, mesal and lateral margins subequal; spiracerores wanting; each lateris on caudal portion with short plate-like projections; pygidium of second nymphal female similar to adult.—Tanga, Africa on *Tectona*.-----*tectonae* Lindgr.
- ee. Pygidium with median pair of lobes not well developed, margin rounded; second pair of lobes represented by simple lobe of border of pygidium; third pair of lobes spiniform; pectinae furcapectinae, arranged 2, 2, 3, 2; pectinae of median incisura but little longer than median lobes, others successively longer, those of each lateris twice as long as lobes, formed with mesal fork much longer than lateral.—France on *Psamma*.-----*provincialis* Vayss.
- cc. Pygidium with five to seven pectinae on each lateris.
  - d. Pygidium with densariae in median incisura; median pair of lobes subquadrangular, longer than broad, entire, truncately rounded, distant; second and third pairs of lobes much smaller, short, entire, bluntly rounded; pectinae elongate, nearly twice as long as median pair of lobes, deeply laciniate, arranged 2, 2, 3, 5-6, those of each lateris very deeply laciniate; anus about four times its width distant from caudal margin; setae of median and second pairs of lobes long, longer than lobes; densariae of second and third incisurae typical.—Canary Islands on *Euphorbia*.----*taorensis* Lindgr.
  - dd. Pygidium not with densariae in median incisura; median pair of lobes longer than broad, subadjacent at proximal end, bluntly rounded, entire; second and third pairs of lobes large and distinct, smaller than median pair, bluntly pointed, indistinct lateral notch; pectinae elongate, distinctly longer

than median lobes, deeply laciniate, those of each third incisura and of lateris unapectinae, arranged 2, 2, 3, 6-7, those of each lateris longer than others; anus over four times its width distant from caudal margin; setae slightly longer than lobes; densariae of second and third incisurae typical.—Canary Islands on *Dracaena*. ----- *tinerfensis* Lindgr.

- bb. Pygidium without pectinae or plates on each lateris.
- c. Pygidium with pectinae or plates of second and third incisurae longer than second and third pairs of lobes.
- d. Pygidium with median pair of lobes with distinct mesal and lateral notches, quadrangular, large, distal end bluntly rounded; second pair of lobes similar in shape, about one-half size of median; third pair of lobes small, pointed; pectinae subequal in length to median pair of lobes, those of second and third incisurae unapectinae, arranged 2, 2, 3, 0; each lateris crenulate with two or three distant truncated plate-like projections; dorsal oracratubae present.—Abyssinia on *Aloe*.----- *mammillaris* Lindgr.
- dd. Pygidium with median pair of lobes entire, large; second and third pair of lobes much smaller, those of third pair dentiform; pectinae small and delicate, arranged 2, 2, 2-3, 0; dorsal oracratubae numerous; cephalic end of pygidium with two transverse calles, mesal and lateral evidently fused.—Algeria on *Ephedra*. ----- *trabuti* Marchal.
- cc. Pygidium with pectinae or plates of second and third incisurae notably much shorter than second and third pairs of lobes, those of third incisurae larger and with some notches, apparently arranged 2, 2, 3, 0; median pair of lobes projecting; second pair of lobes triangular, mesal side parallel with meson, lateral side oblique, continuous with margin of pygidium; third pair of lobes similar in form to second, but smaller and more obtuse; setae long, extending much beyond lobes; paraphyses wanting; bundle of long and straight ceratubae on each side of pygidium.—South Tunis on *Nitraria*.----- *nitrariae* Marchal.
- aa. Pygidium without pectinae or plates in median incisura.
- b. Pygidium with pectinae or plates on each lateris.
- c. Pygidium with pectinae in incisurae.
- d. Pygidium with mesal densariae of second incisurae larger than lateral, its cephalo-lateral angle produced; median pair of lobes subquadrangular, mesal margins strongly convergent, lateral and distal margins rounded, prominent lateral notch; second and third pair of lobes minute, triangular, second pair much broader than third; pectinae deeply laciniate, arranged 0, 2, 3, 4-5, those of each lateris and of incisurae unapectinae; cephalic end with four calles; setae long and slender.—Canada, District of Columbia, Mexico, Demerara on basswood, lilac.----- *diffinis* Newst.
- dd. Pygidium with mesal and lateral margins of densariae of

second incisurae subequal and symmetrical.—Mexico on  
 “Barenjeno Chiquito.” -----*diffinis parrotti* Newell.

- cc. Pygidium with plates in incisurae; median pair of lobes prominent, nearly as long as broad, mesal margins subadjacent, lateral notch, sometimes wanting; second pair of lobes longer than broad, sometimes with lateral notch; third pair of lobes inconspicuous, small, pointed; second and third incisurae with densariae, mesal margin longest and stouter than lateral; plates in incisurae small, furcapectinae and one plate on lateres, arranged 0, 1, 2, 6, those of each lateris arranged 3-1-1-1, plate at cephalic end, swollen at proximal end; anus about seven times its width from caudal margin and about twelve times from vulva; mesal calles fused, distant from lateral calles, each of latter only about three times as long as broad.—Cuba on Faberna. -----*fabernii* Houser.
- bb. Pygidium without pectinae or plates on lateres, arranged 0, 1, 0, 0; median pair of lobes large, broader than long, two mesal and one lateral notch, bluntly rounded; second and third pairs of lobes small, crenulate, rounded, inconspicuous; lateres crenulate; setae long, projecting beyond median pair of lobes; mesal calles fused and widely separated from lateral calles; anus near caudal margin; densariae of second and third incisurae distinct, wanting between median pair of lobes.—Canary Islands on Laurus, Apollonias. -----*aonidioides* Lindgr.

#### SPECIES OF COMSTOCKASPIS

- a. Pygidium with pectinae on each lateris.
- b. Pygidium with median pair of lobes with lateral notch, distal end broadly rounded, mesal margins not distant; second pair of lobes minute, only slightly projecting, distal margin broadly emarginate or with broad lateral notch; plates small, arranged 2, 2, 6, those of each lateris arranged in two groups, one group associated third densariae and a group of three pectinae located cephalad of cephalic group of plates.—*Aspidiotus perniciosus albopunctatus* Ckll., *Aspidiotus perniciosus andromelas* Ckll.—Canada, United States, Chili, Hawaiian Islands, Japan, China, Australia, Germany on apple, pear, peach, quince, apricot, plum, walnut, almond, poplar, chestnut, sumac, catalpa, willow, osage-orange, linden, ash, elm, dogwood, orange, lemon, elder, maple, rose, currant, raspberry, pecan, milkweed, spruce, cedar, etc. -----*perniciosus* Comst.
- bb. Pygidium with median pair of lobes with mesal and lateral notch.
- c. Pygidium with six pectinae on each lateris, pectinae long, well developed, much longer than setae, arranged 2, 2, 6, those of each lateris unapectinae, deeply lacinate; median pair of lobes large, projecting, constricted at proximal end, triangular, strongly emarginate on lateral margin, small notch on mesal margin; second pair of lobes subadjacent to median, similar in form, much smaller, single lateral notch; dorsal oracreratubae in longitudinal rows.—South Algeria on Zilla. ....*securati* Marchal.

- cc. Pygidium with nine pectinae on each lateris, pectinae long, longer than median lobes, deeply lacinate, arranged 2, 2, 9, those of each lateris unapectinae, not as deeply lacinate as others, forming group cephalad of second lobe; median pair of lobes quadragular, distal end bluntly rounded, deep lateral and mesal notches; second pair of lobes longer than broad, deep lateral and faint mesal notches, bluntly pointed; each side of pygidium near cephalic portion of lateres with group of 19-32 dorsal oracratubae.—South Africa on Ehretia, Anacardiaceae, Illigera, Mitrangune. -----*replicata* Lindgr.
- aa. Pygidium with three plates on each lateris, plates arranged 0, 2, 3; median pair of lobes adjacent, large, broad and short, bluntly rounded, lateral notch; second pair of lobes short, broad, pointed, subobsolete; two pairs of densariae, well formed, pyriform, lateral margin of each second densaria largest; anus over three times its width from caudal margin and five times from vulva.—New Mexico, California on pinus, Libocedrus, Cupressus.-----*coniferarum* Ckil.

SPECIES OF CHEMNASPIDIOTUS

Pygidium with median pair of lobes distinct, broader than long, mesal and lateral notches; densariae in second and third incisurae, wanting in median incisura, subequal; plates arranged 2, 5 to several, those of each lateris arranged, two in each second incisura, three in third incisura, and several on each lateris; setae longer than lobes; dorsal oracratubae few; anus twice its width from caudal margin; living in galls on leaves.—District of Columbia, Georgia, Mississippi on Liquidambar.---*liquidambaris* Kotinsky.

SPECIES OF HENDASPIDIOTUS

- a. Pygidium with densariae of second incisurae normal in length, never greatly elongated.
- b. Pygidium with pectinae or plates in median incisura.
- c. Pygidium with plates in median incisura.
  - d. Pygidium with densariae in median incisurae; median pair of lobes as long as or longer than broad, rectangular, mesal and lateral margins straight, angles prominent; two plates in median incisura and five pectinae and three short plates on each lateris.—Mexico. -----*tricolor* Ckil.
- dd. Pygidium not with densariae in median incisura.
  - e. Pygidium with median pair of lobes broader than long, mesal margins parallel, not converging, quadragular, distal end bluntly rounded, distinct lateral and faint mesal notches; densariae of second incisurae large, subequal in length, those of third incisurae much smaller, subequal; plates minute, inconspicuous, arranged 2, 2-1; mesal calles strongly thickened, near together, distant from oblique lateral calles; anus large, about twice its own width from caudal margin.—South Africa on Robinia.---*africanus* Marl.
  - ee. Pygidium with median pair of lobes broader than long, distant, mesal margins converging, rounded, broadest at



middle, edges obscurely crenulate; pectinae large, narrow, longer than lobes, arranged 2, 11, those of each lateris close together; anus circular, located near proximal ends of lobes; second and third incisurae with densariae.—Mexico on Cupressus. -----*cupressi* Ckll.

- cc. Pygidium with pectinae in median incisura, pectinae distinct, comb-like, not notched, form of rounded knife-blades, arranged 2, 10, those of median incisura and of each lateris formed and arranged so as to make perfect contour with lobes; median pair of lobes large, others wanting; cephalic end of pygidium with three transverse calles.—Senegal, Africa on *Balanites*.-----*vuilleti* Marchal.
- bb. Pygidium without pectinae or plates in median incisura.
  - c. Pygidium with about eight plates, adjacent to median lobe, on each lateris; median pair of lobes quadrangular, distal end truncately rounded, distinct mesal and lateral notches; densariae marking position of second and third incisurae, mesal margin of densariae of second incisurae much longer than lateral; mesal and lateral calles distinct, subequal in length, equidistant from each other.—Illinois, New York, Kansas, Japan on elm, Catalpa, Cycas. -----*ulmi* Johns.
  - cc. Pygidium never with eight plates on each lateris adjacent to third lobe, usually few in number.
    - d. Pygidium with median pair of lobes large, two prominent lateral notches, mesal angle of each protuberant and rounded, mesal notches wanting; second and third pairs of lobes marked by densariae; mesal margin of densariae of each second incisura but little longer than lateral; much broader, densariae of third incisurae not prominent; plates inconspicuous; mesal calles subhyaline, inconspicuous, lateral calles distinct.—Transcaspian Russia on *Populus transcaspensis* Marl.
    - dd. Pygidium with median pair of lobes large, each with single prominent lateral notch, mesal margins straight, distant, distal ends bluntly rounded; plates and pectinae inconspicuous, not as long as lobes, arranged 0, 2, those of each lateris arranged 1-1, cephalic one a pectina; densariae large, mesal and lateral margins subequal; setae large, prominent, longer than lobes.—not *Aspidiotus alni* Marchal.—Austria on *Quercus*.-----*alni* Lindgr.
- aa. Pygidium with densariae of second incisurae with mesal side greatly elongated, straight, enlarged at apex, club-shaped, lateral margin shorter and only slightly enlarged, mesal margin inversely carrot-shaped; densariae of third incisurae subequal; median pair of lobes with two small proximal processes; median pair of lobes rather long, rounded, sometimes notched; second pair of lobes usually slightly doubly concave; setae fairly large; plates minute, spine-like, hardly to be seen, not detectable according to Newell; anus near caudal margin, transverse; dorsal oracratubae present.—Mexico on *Caesal-pina*. -----*substmitis* Ckll.

SPECIES OF CLAVASPIS

- a. Pygidium with median pair of lobes with mesal and lateral notches, prominent, lateral margin oblique, adjacent, distal ends rounded; densariae prominent, mesal margin of those of second incisurae over three times as long as lateral margin, cephalic end greatly enlarged, rounded, ball-like, densariae of third incisurae small, normal in form; plates small, inconspicuous, arranged 0, 8-9, those of each lateris arranged 2-2-2-2 or 3, two in second incisurae, two in third incisurae, two just cephalad of third incisurae, and two or three farther cephalad; setae long, slender, about as long as lobes; anus longer than broad, distant five times its width from caudal margin and sixteen or more times from vulva.—*Aspidiotus subsimilis* anonae Houser.—Florida, Peru on *Mangifera*, *Anone*.-----  
*anonae* Houser.
- aa. Pygidium with median pair of lobes with prominent lateral notch, large, subadjacent, distal ends bluntly rounded; second pair of lobes small, inconspicuous; densariae of second incisurae large, prominent, those of mesal margin much broader, three or more times as long as lateral, rounded, club-shaped, those of third incisurae subequal in length, small, swollen; plates small, inconspicuous, arranged 0, 2, 3, those of each lateris arranged in two groups, one in third incisurae and two much shorter ones some distance cephalad; anus distant about twice its width from caudal margin; setae longer than plates.—Society Islands. -----*herculeana* Doane & Hadden.

SPECIES OF PELOMPHALA

- a. Pygidium with nine pairs of paraphyses; body with cephalic portion on each side with tooth-like projection.
- b. Pygidium with median pair of lobes with lateral notch, narrow in form, pointed, near together, not touching; second, third, and fourth pairs of lobes broader than median, similar, except second and third have mesal and lateral notches, fourth serrate; each lateris crenulate, with about five small prominences; plates short and inconspicuous; paraphyses in nine pairs, seven short and two long pairs, short ones considerably longer than lobes.—*Chrysomphalus calurnus* Ckll.—Mexico on *Crataegus*. -----*calurna* Ckll.
- bb. Pygidium with median pair of lobes with distinct mesal and lateral notches, quadrangular, broadly rounded between notches, mesal and lateral margins parallel, distant; second, third, and fourth pairs of lobes with mesal margin longer than lateral, distal margin oblique, notched, second pair broader than median, others successively broader; each lateris coarsely, irregularly toothed; plates shorter than lobes, inconspicuous, arranged 0, 0, 2, 2, 0; paraphyses in nine pairs, sixth pair short and third pair long, second, fifth, and eighth pairs long, third and ninth pairs subequal, slightly shorter than subequal first and sixth pairs and slightly shorter than fourth; anus located near middle of pygidium; callosities continuous, united with lateral thickenings; body with margin more or less strongly and finely crenulate.—British Gulana on *Avicennia*. -----*apicata* Newst.

- aa. Pygidium with four pairs of paraphyses; lobes in four pairs, median pair entire, second pair with single notch, third pair minutely serrate with four notches, and fourth pair broad and serrate; each lateris with three small prominences; anus located considerable distance from caudal margin.—New Mexico on *Quercus*.----*Uilacina* Ckll.

## SPECIES OF MYCETASPIS

Body with broad, rotund, cephalic, constricted, head-like area; median pair of lobes triangular, entire or faintly notched; second pair of lobes broad, shorter than median, one or more notches; third pair of lobes as broad as second, distal margin dentate; plates short, rudimentary, arranged 1, 2, 2, 3, those of each lateris not longer than third lobe, one of median incisura deeply bifurcate; each lateris with three broad, serrate, lobe-like projections on caudal half; paraphyses arranged in four pairs, first pair longest, associated with second incisurae, second pair with third incisurae, slightly shorter than first, third and fourth pairs near together, associated with cephalic end of third lobe.—West Indies, Mexico, Guiana, England on orange, Areca, Sabol, Jasminum, plantain, banana, mango, fig, *Tillandisia*, *Anacardium*.-----

*personata* Comst.

## SPECIES OF PARAONIDIELLA

Pygidium with median pair of lobes narrow, bluntly rounded, mesal and lateral margins subparallel; second pair of lobes much broader than long, deeply incised, mesal lobelet larger than lateral, lobelets truncate; third pair of lobes short, wider than mesal lobelet, subtruncate; pectinae short, broad distapectinae, not projecting beyond lobes, arranged 2, 2, 2, 0; each lateris irregularly indented with very large prominent seta near middle of its length; paraphyses arranged in eight pairs, eighth pair longest, third pair next in length, others much shorter.—Australia, Natal, south Africa on *Cladium*, *Lepidosperma*, *Xerotes*, sedges, aloe.-----*cladii* Mask.

## SPECIES OF AONIDIELLA

- a. Pygidium with seven or eight pairs of paraphyses.
- b. Pygidium with nine pairs of paraphyses, second, fifth, and ninth pairs subequal and longest, seventh pair one-fourth shorter than ninth and next in length, first, third, sixth, and eighth pairs subequal and slightly shorter than seventh, fourth pair one-third shorter than third and shortest; median pair of lobes broader than long, rounded, slightly oblique; second and third pairs of lobes similar, subequal, lateral margins oblique, crenulate; lateres with lobe-like projections; pectinae subequal in length to lobes, furcapectinae, arranged 1, 2, 2, 2, those of each lateris adjacent to third lobe.—South Africa on *Acacia* (not *Mimosa*).-----*phenax* Ckll.
- bb. Pygidium with less than nine pairs of paraphyses.
- c. Pygidium with eight pairs of paraphyses, second pair one-half length of first, slightly longer or subequal to second, third, fifth, sixth, and eighth pairs longest and slightly longer than subequal first and seventh; median pair of lobes rounded, one or more lateral notches; second pair of lobes longer than

broad, lateral margin strongly oblique, dentate, mesal angle bluntly rounded; third pair of lobes similar to second pair; pectinae short, inconspicuous furcapectinae or plates, arranged 0 2, 2, 2; each lateris with indentations.—Mexico on *Mimosa*.—*mimosae* Comst.

cc. Pygidium with seven pairs of paraphyses, second pair longer than first or third, fourth and sixth pairs longest, slightly longer than second, fifth pair slightly shorter than second and longer than first and seventh; median pair of lobes subquadrangular, mesal and lateral notches; second pair of lobes smaller, subquadrangular, mesal and lateral notches; third pair of lobes broader than long, bluntly pointed, lateral margin crenulate; lateres irregularly toothed and crenulate; pectinae comparatively broad distapectinae, arranged 2, 2, 2, 2, those of each lateris furcapectinae.—District of Columbia, Georgia, California on maple, apple.-----*tenebricoa* Comst.

aa. Pygidium with six or less pairs of paraphyses.

b. Pygidium with five or six pairs of paraphyses.

c. Pygidium with second and third pairs of paraphyses subequal and longer than fourth, first, fourth, and sixth pairs subequal, all short.

d. Scale of adult female reddish or brownish; median pair of lobes rounded, mesal and lateral notches; second pair of lobes similar in shape, mesal and lateral notches or lateral margin oblique and crenulate; third pair of lobes similar, lateral and sometimes mesal notches; pectinae subequal in length to lobes, median and second incisurae with narrow distapectinae, others unapectinae, arranged 2, 2, 3, 3; calli four in number.—New York, Florida, Ohio, California, West Indies, Hawaiian Islands, Fiji, Samoa, New Caledonia, New Zealand, Australia, Japan, China, Ceylon, Mauritius, south Africa, Syria, southern Europe on orange, lemon, cocoanut, fig, olive, agave, plum, rose, pear, quince, apple, willow, oak, grape, etc. -----*aurantii* Mask.

dd. Scale of adult female always yellowish in color, insects on leaves of fruit only.—California, Japan on *Euonymus*, *Aucuba*, orange. -----*aurantii citrina* Coq.

cc. Pygidium with second pair of paraphyses longer than third and distinctly shorter than fourth, longest, fifth and sixth pairs subequal or shorter than third, first and third pairs subequal; median pair of lobes bluntly rounded, mesal and lateral notches, broader than long; second pair of lobes narrower than median, deep lateral notch; third pair of lobes smaller than second, bluntly rounded, lateral notch distinct; pectinae arranged 2, 2, 3, 6, those of lateres unapectinae, others distapectinae.—Italy on *Taxus*.-----*tara* Leon.

bb. Pygidium with less than five pairs of paraphyses.

c. Pygidium with four pairs of paraphyses.

- d. Pygidium never with long fusiform mesal paraphyses extending to and sometimes cephalad of anus.
- e. Pygidium with second pair of paraphyses longest, twice as long as third, shortest, first and fourth pairs intermediate and subequal; median pair of lobes broadly rounded, broader than long, entire; second and third pairs of lobes broader than median, short, emarginate or irregularly notched; plates short, not longer than lobes, arranged 2, 2, 2, 2; lateres crenulate.—England on pine-apple.-----  
*bromeliae* Leon.
- ee. Pygidium with first and second pairs of paraphyses subequal and twice as long as subequal third and fourth pairs; paraphyses large, conspicuous, knobbed at cephalic end; median pair of lobes triangular, adjacent, bluntly pointed, lateral margin longest, deeply notched; second pair of lobes triangular, minute, entire; third pair of lobes similar, smaller; pectinae subequal in length to median pair of lobes, arranged 2, 2, 3, 2-3; setae long, as long as pectinae; anus small, over five times its width from caudal margin; mesal calles fused, lateral calles short and distant from mesal.—Northern Australia on *Ficus*.-----  
*subcuticularis* Green.
- dd. Pygidium always with long fusiform mesal paraphysis extending to or beyond anus, other paraphyses situated, two on median lobes, mesal two-thirds length of lateral, one more or less club-shaped, much longer and stouter than first two, situated just laterad of median lobe, and similar one at mesal side of proximal end of second pair of lobes; median pair of lobes quite broad, united except distal third, distinct lateral notch; second pair of lobes scarcely broader, oblique, minutely serrate, bearing about five teeth, separated from median lobe by space equal to width of both median lobes; third pair of lobes about two-thirds width of second, similar in shape, serrate with about three teeth; furcapectinae arranged 1, 25, 3, ?, and several plates of varying length on lateres; thorax separated from abdomen by lateral indentation.—India. -----*minuta* Kotinsky.
- cc. Pygidium with less than four pairs of paraphyses.
- d. Pygidium with three pairs of paraphyses.
- e. Pygidium with pectinae on each lateris, pectinae subequal in length with lobes, arranged 2, 2, 3, 3, those of each lateris unapectinae, longer than lobes; median pair of lobes elongate, constricted on proximal portion, distal portion bluntly rounded, floriate, faint mesal and lateral notches; second and third pairs of lobes similar, third pair slightly smaller; all three pairs of paraphyses subequal, on mesal side of proximal end of each lobe.—Ceylon on *Phyllanthus*. -----*laprobana* Green.
- ee. Pygidium without pectinae or plates on each lateris.

- f. Pygidium with three pairs of lobes; median pair of lobes narrow, rounded; second and third pairs of lobes broader than long, lateral margin oblique, notched; pectinae not longer than lobes, furcapectinae, arranged 2, 2, 2, 0; lateres irregularly dentate; paraphyses with second and third pairs subequal in length and two or more times as long as first pair.—Massachusetts, Galapagos Islands on smilax, Croton. -----*smilacis* Comst.
- ff. Pygidium with four pairs of lobes; median pair of lobes somewhat triangular, distal end with distinct point, distinct mesal and lateral notches; second pair of lobes narrower than median, longer than broad, convergent caudad, distal end rounded or pointed, distinct lateral notch; third pair of lobes as broad as long, rounded at distal end, mesal and lateral notches, mesal sometimes faint; fourth and fifth pairs of lobes more or less distinct, triangular, serrated, these probably projections; pectinae arranged 2, 2, 3, 3, 0; paraphyses short, club-shaped, pair located opposite second, third, and fourth incisurae, between incisurae named and between median pair of lobes with a chitinous knob.—Ceylon on Pothos. -----*pothi* Green.
- dd. Pygidium with two pairs of paraphyses.
  - e. Pygidium with one paraphysis located in each second and third incisura, mesal paraphyses slightly larger than lateral; three pairs of lobes, median pair broad, truncately rounded, entire; second pair of lobes smaller than median and larger than third; third pair bluntly rounded; pectinae slender, arranged 2, 2, 3, 0; lateres strongly, irregularly serrate; vulva located some distance cephalad of anus; calles distinct, mesal calles fused.—*Targionia glomerata* Green.—India on *Saccharum*.--*glomerata* Green.
  - ee. Pygidium with paraphyses located two in each second incisura, mesal about twice as long as lateral and extending cephalad beyond level of anus; two pairs of lobes; median pair of lobes large, elongate, mesal margins practically contiguous, distal end rounded, strong lateral notch; second pair of lobes of same general shape as median, very much smaller, more pointed, notch stronger; each lateris short distance cephalad of second lobe with two small pointed projections, cephalad of these three large broad strap-shaped pectinae, cephalad of these two small pointed projections, margin cephalad of these serrulate; vulva located some distance cephalad of anus.—Philippine Islands on "rosal" or "campopot."-----*tayabana* Ckll.

SPECIES OF MONAONIDIELLA

- a. Pygidium with a single pair of paraphyses.
- b. Pygidium with median pair of lobes adjacent, ends rounded and emarginate; plates short and spiniform; each lateris serrate with

- large widely forked furcapectinae near median lobe; paraphyses two in number, associated with median pair of lobes.—Australia on Acacia, Templetonia. -----*cerata* Mask.
- bb. Pygidium with median pair of lobes sharply truncate, without lacinations, not emarginate; lateres not with large widely forked furcapectinae.—West Australia on Acacia. -----*nivea* Fuller.
- aa. Pygidium with four pairs of paraphyses; median pair of lobes large, prominent, strongly convergent, prominent lateral notch, lateral margin oblique, distal end rounded; median incisura narrow, without plates; indentation marking second incisura with two short plates and two subequal clavate paraphyses, as long as or longer than median lobe; minute projection cephalad of second incisura, probably representing lobe, cephalad of this a plate; two cephalic paraphyses of each side adjacent, clavate, as long as caudal paraphyses; single plate cephalad of cephalic paraphyses; anus distant from caudal margin; dorsal oracercatubae few and inconspicuous.—Australia on Acacia. -----*subfervens* Green.

## SPECIES OF NEOLEONARDIA

Pygidium with median pair of lobes fused into a single lobe, circular, entire; each lateris with four stout truncate plates, in two groups of two each, separated by indentation, another indentation cephalad of cephalic group of plates, each indentation with two long setae, plates nearly as long as lobes; paraphyses four in number, cephalic portion swollen, club-shaped, mesal paraphyses longer than lateral, shortest three or more times as long as median lobe; caudal portion of pygidium constricted and margins emarginate.—Australia on Eucalyptus.-----*extensa* Mask.

## SPECIES OF GREENOIDEA

Pygidium with median pair of lobes short, rounded, faint lateral and mesal notches; second, third, and fourth pairs of lobes similar, rounded, smaller than median, lateral notch; paraphyses two or three times as long as wide, attached mesal margin of second, third, and fourth pairs of lobes; proximal ends of median pair of lobes prolonged; calles present; plates or pectinae wanting; anus near middle of pygidium.—Ceylon on Phyllanthus. -----*phyllanthi* Green.

## SPECIES OF MASKELLIA

Pygidium with median pair of lobes rounded at distal end, entire; second and third pairs of lobes short and broad, notched at distal end, distance between them three times distance between median and second lobe; each lateris with projections at middle; setae on ventral side of proximal end of lobes and lobe-like projections and on dorsal side of second and third pairs of lobes and lobe-like projections; anus slightly nearer caudal than cephalic end of pygidium; insects forming galls on twigs.—West Australia on Eucalyptus.-----*globosa* Fuller.

## SPECIES OF TARGASPIDIOTUS

- a. Pygidium with median pair of lobes concave at distal end; thorax not at all transversely constricted.

- b. Pygidium with median pair of lobes quadrangular, concave at distal end; second pair of lobes as broad at distal end as at proximal; densariae of second incisurae with mesal margin about twice as long as lateral.—Kansas on *Andropogon*, *Panicum*, *Chrysopogon*.-----*marlatti* Parr.
- bb. Pygidium with median pair of lobes quadrangular, lateral margin longest, concave; second pair of lobes as broad as median, similar in shape; third pair of lobes similar in form, much smaller; second and third incisurae with densariae, mesal margin longer than lateral; dorsal oracratubae numerous, arranged in three rows; anus about seven times its width from caudal margin and about twice from vulva.—*Chrysomphalus tonilensis* Ckll., *Chrysomphalus covilleae* Ferris.—New Mexico, Arizona on *Yucca*, *Bigelowia*, *Covillea*.-----*yuccarum* Ckll.
- aa. Pygidium with median pair of lobes never concave at distal end.
  - b. Pygidium with median pair of lobes quadrangular, bluntly rounded, entire; second and third pairs of lobes similar in form, subequal in size, all about as broad at distal as at proximal end; mesospiracerones 6; segments of preabdomen with numerous large dorsal oracratubae.—Australia on *Casuarina*.-----*casuarinae* Mask.
  - bb. Pygidium with median pair of lobes adjacent, longer than wide, mesal and lateral notches; second pair of lobes narrower, sides nearly straight, large lateral notch; third pair of lobes small, bluntly pointed; median and second incisurae narrow, lobes adjacent third incisurae broad; plates or pectinae wanting; median setae inconspicuous, others prominent; second incisurae apparently with thickenings.—Australia on *Dryandra*.-----*dryandrae* Fuller.

SPECIES OF PYGIDIASPIS

Pygidium of adult female with median and second pairs of lobes similar, broad, short, three or more times as broad as long, distal margin obscurely notched on each side and slightly projecting between notches, placed close together, with long thickened broad paraphysis-like projections extending cephalad from proximal ends; each lateris with three broad projections, similar in form to lobes, broader, distal margin faintly crenulate, without paraphysis-like projections, cephalic one of each side smallest, distance between it and median one twice that between caudal and median; conspicuous translucent curved channel extending cephalad for distance equal to width of lobes; anus minute, located between channels.—Australia on cedar logs.-----*cedri* Green.

SPECIES OF TARGIONIA

- a. Pygidium with strong tooth-like projections on each lateris.
- b. Pygidium with tooth-like projections of lateres arranged in pairs.
- c. Pygidium with median pair of lobes with distal end bluntly rounded, quadrangular, distant, not converging, faint mesal and prominent lateral notches; setae small.—France, Italy, Algiers on *Vitis*.-----*vitis* Sign.



- cc. Pygidium with median pair of lobes projecting, distal end truncate or subtruncate, faint lateral notch.—Italy on *Quercus*...  
*vitis suberi* Leon.
- bb. Pygidium with tooth-like projections of lateres not arranged in pairs.
  - c. Pygidium with two tooth-like projections on each lateris, similar to second and third pair of lobes, not projecting beyond general contour of margin of pygidium; lateres very oblique; median pair of lobes large, convergent, strongly projecting; large bifurcate thickening prolonged inside lobes of each side to anus; marginal setae prominent; pectinae or plates wanting.—France on *Alnus*. ----- *alni* Marchal.
  - cc. Pygidium with three tooth-like projections on each lateris, becoming successively smaller cephalad, located near median lobes, remainder of each lateris entire; median pair of lobes small, rounded, distinct lateral and faint mesal notches, near but not contiguous; anus located four times its width from caudal margin; pectinae and plates wanting; dorsal oracera-tubae few in number, arranged near peripheral margin.—*Aonidia juniperi* Marl.—Utah on *Juniperus*----- *juniperi* Marl.
- aa. Pygidium without strong tooth-like projections on lateres.
  - b. Pygidium with median pair of lobes large and projecting.
    - c. Pygidium with median pair of lobes large, prominent, projecting, somewhat convergent, distinct mesal and lateral notches; setae prominent, two located between median pair of lobes and five on each lateris in two groups, three near median lobe and two some distance cephalad of these.—France on *Cineraria*, *Quercus*. ----- *nigra* Sign.
    - cc. Pygidium with median pair of lobes prominent, projecting, distant, subtriangular, distal end bluntly rounded, lateral notch; second and third pairs of lobes indicated as slight triangular projections; setae prominent, four on each side, one on each median lobe and each projection indicating second and third lobe and one on each lateris; anus distant from caudal margin two or three times its width.—Argentina on *Fabiana*-----  
*fabianae* Leon.
  - bb. Pygidium with median pair of lobes very short, not projecting, distinct lateral and mesal notches on caudal margin with margin bluntly pointed and projecting between them; lateres coarsely crenulate with these undulations finely crenulate; setae minute; pygidium of second nymphal female with three pairs of lobes, median pair large with distinct lateral notch; second pair of lobes smaller with lateral notch; third pair of lobes small, triangular with mesal and lateral notches; pectinae longer than lobes, arranged 2, 2-3-2-3.—*Chrysomphalus barbusano* Lindgr.—Canary Islands on *Phoebe*. ----- *barbusano* Lindgr.

## SPECIES OF AFFIRMASPIIS

- a. Pygidium with *densariae* distinct, caudal one largest, mesal and lateral margins equal; median pair of lobes large, mesal margins

straight, near to but not touching, distal and lateral margins convex, lateral angles not conspicuous, faint lateral notch; second pair of lobes long, longer than broad, two distal notches, mesal margin nearly straight, distal and lateral contours pointed; setae, particularly of each lateris, very long, longer than median pair of lobes; each lateris with broad, blunt, tooth-like projections; anus located near caudal margin.—Sokotra, Africa on *Dracaena socotrana* Lindgr.

- aa. Pygidium with densariae distinct, caudal one largest, mesal margin much larger, nearly twice, than lateral; median pair of lobes large, mesal margins convex, distant, lateral margin oblique, notched, distal end bluntly rounded; second pair of lobes similar to median, much smaller, lateral notch; setae prominent; each lateris without tooth-like projections, entire or finely serrate; anus nine times its width from caudal margin.—South Africa on *Ehretia*—*chretiae* Brain.

SPECIES OF TARGIONIDEA

- a. Pygidium with median pair of lobes with three distinct lateral notches, large, triangular, subadjacent, convergent; densariae wanting in median incisura, large, two margins subequal in second incisurae, smaller in third, margins subequal; setae long and stout, longer on median pair of lobes, seven on each side, four dorsal and three ventral; pygidium of first nymph with single pair of lobes and without pectinae or plates.—Canary Islands on *Campylanthus*.-----  
*campylanthi* Lindgr.
- aa. Pygidium with median pair of lobes with single notch, large, projecting, subadjacent; second incisurae bounded by small, unsymmetrical, triangular, notched, lobe-like projections; densariae of second incisurae with margins subequal; setae long and stout, subequal or longer than median pair of lobes, six on each side, three dorsal and three ventral.—Denmark on *Euphorbia*, *Olea*. *lenticularis* Lindgr.

SPECIES OF CIRCULASPIS

Pygidium with deep mesal indentation and three others on each side; projections of margin of pygidium between indentations serrate; "conspicuous cylindrical canal" extending cephalad from mesal cleft over half way to anus, terminating in "brush of small tubular ducts;" dorsal and ventral surfaces dotted with minute circular pores with thickened rims; anus near cephalic end of pygidium; mesospiracerores and metaspiracerores numerous.—India on bamboo.-----  
*canaliculata* Green.

SPECIES OF RUGASPIDIS

- a. Pygidium with three indentations on each side; mesal projection with slight mesal groove; margin of pygidium shallowly crenulate; anus located slightly cephalad of vulva, about fifteen times its width from caudal margin; mesospiracerores present; dorsal oraceratubae numerous, irregularly placed.—California on grass.—*graminis* Bremner.
- aa. Pygidium with numerous slight indentations, margin appearing to have three pairs of indefinitely defined lobes with coarse crenulations; dorsal oraceratubae numerous, without definite arrangement, associated more or less with wrinkles of surface; setae long, slender,

four ventral and three dorsal, dorsal and ventral seta located on each lobe-like projection; anus large, about eight times its width from caudal margin and three times from vulva.—*Diaspis arizonica* Ckll. (Ferris).—Arizona on *Prosopis*.-----*arizonica* Ckll.

## SPECIES OF OBTUSASPIS

*Pygidium* without lobes, pectinae, or plates; margin with about thirty subquadrate, irregular, truncate, closely adjacent projections; meson of caudal margin slightly incised with largest projection forming lateral limits of incision, three much smaller projections in incision, others successively smaller cephalad; *pygidium* short, very broad, broadly rounded; dorsal oraceratubae small, few in number; anus and vulva nearly superimposed, located near middle of cephalic half; *pygidium* with inverted V-shaped thickenings with three large pores or minute setae laterad of each side of V; scale of adult female dense, hard, capsulate, two halves slightly separated at caudal end, probably a puparium.—British East Africa on roots of *Chloris*.-----*rhizophila* Newst.

## SPECIES OF LEONARDIANNA

- a. *Pygidium* with four pairs of paraphyses, eight paraphyses, mesal pair shortest, fourth pair longest, second and third pairs subequal; margin of *pygidium* with four rounded lobular projections on each side, entire, bearing three distant setae on cephalic half; scale dull grayish brown.—California on *Bigelovia*.-----*bigeloviae* Ckll.
- aa. *Pygidium* with seven subequal paraphyses, one located on meson, others in pairs; margin of *pygidium* with three or four rounded lobular projections on each side; cephalic half of *pygidium* on each side, preabdomen, thoracic segments, and margin of head with scattered setae and numerous small circular pores, latter not extending cephalad of mesospiracles; surface of *pygidium* longitudinally striate; margin of *pygidium* on each side finely dentate; mesospiracerores 3-8; anus and vulva superimposed, located at middle of *pygidium*.—Jamaica on *Pimenta*.-----*pimentae* Newst.

## SPECIES OF FROGGATTIELLA

- a. *Pygidium* with two pairs of paraphyses, second pair very slightly longer than first; *pygidial* margin with broad mesal emargination, another adjacent to each second paraphysis, two distant deep angular notches cephalad of these, minutely irregularly serrate; pair of setae caudad of caudal end of each paraphysis, another caudad of caudal notch, two distant setae on each side of areas on each side of cephalic notch; anus small, located cephalad of line drawn through cephalic notches; spiracerores present.—Ceylon on *Arundinaria*.-----*inustitata* Green.
- aa. *Pygidium* with three pairs of subequal paraphyses, three or four times as long as broad; *pygidium* incised on meson with three prominent angular equidistant teeth on each side with smaller teeth between them; mesal incision provided with dense brush of long tapering setae, distal ends meeting in point; anus located near cephalic end of *pygidium*; dense chitinous area with numerous minute circular pores.—Ceylon on *Gigantochloa*.-----*pentillata* Green.

SPECIES OF STRINGASPIDIOTUS

- a. Pygidium with four pairs of lobes; median pair large, conspicuous, pointed, mesal and lateral notches; second and third pairs of lobes narrow, lanceolate, constricted at proximal end; fourth pair of lobes broad, distinct, mesal and lateral notches; pectinae subequal in length to lobes, arranged 2, 2, 3, 3, 0; each lateris irregularly dentate; mesospiracerores 3-4; anus distant from caudal margin; genacerores (12-12)12-12.—Java on *Curculigo*.----*curculiginis* Green.
- aa. Pygidium with three pairs of lobes; median pair of lobes as broad as long, distal end bluntly rounded, lateral notch deep, mesal notch faint; second pair of lobes with lateral margin in part oblique, mesal and lateral notches faint; third pair of lobes three times as long, pointed, spine-like; pectinae arranged 2, 2, 3, 5, those of incisurae distapectinae, those of third incisurae very broad, those of each lateris unapectinae; setae short, not one-half length of lobes; body with mesal part of cephalic margin toothed or deeply crenulate; genacerores (4-9)6-6; anus distant from caudal margin.--*Selenaspidus ferox* Lindgr., *Selenaspidus articulatus* celastri Mask.—Cape of Good Hope, Gold Coast, Africa on *Celastrus*, Plumiera-like *Euphorbiaceae*.--*celastri* Mask.

SPECIES OF SEMELASPIDUS

- a. Pygidium with anus distant from caudal margin about twice its length; median pair of lobes small, rounded, entire; second and third pairs of lobes smaller, slightly notched; second and median pairs of lobes much closer together than second and third; each lateris irregularly serrate; paraphyses four in number on each side, slender, median pair longest; pectinae narrow, obscurely lacinate; mesospiracerores numerous; genacerores in three groups, median 4-6, lateral 3-6.—India on leaves of unidentified tree.--*triglandulosa* Green.
- aa. Pygidium with anus distant from caudal margin about three times its length; median pair of lobes triangular, bluntly pointed, sides slightly emarginate; second pair of lobes smallest, near median pair; third pair of lobes triangular, larger than median pair; pectinae small and inconspicuous; paraphyses four in number on each side, median pair slightly longer than others, these subequal; each lateris with prominent serrate projections; genacerores in three groups, median 2-4, lateral 2-5.—Ceylon on *Cinnamomum*.--*cistuloides* Green.

*Aspidiotus capsulatus* Green from Java on *Piper* has a similar scale and undoubtedly belong to this genus.

SPECIES OF SELENASPIDUS

- a. Body with cephalic margin entire or finely or distinctly serrate, never crenulate with projections of two sizes.
- b. Body with mesothoracic marginal spine suddenly drawn out, conical, bluntly pointed, length about equal to greatest width; median pair of lobes entire, rectangular, frequently with faint lateral notches, distal end bluntly rounded, longer than broad; second pair of lobes broader than median, subequal in length, lateral margin obliquely rounded, one or two notches, distal end

- rounded; third pair of lobes long, slender, spine-like, distant from second pair; pectinae as long as lobes, arranged 2, 2, 3, 4-5, those of median and second incisurae furcapectinae, of third incisurae broad distapectinae, and of lateres unapectinae; genacerores in two groups of 6-8 cerores each; calles present, mesal fused.—*Selenaspidus articulatus simplex* Charm.—England, West Africa, Demerara, West Indies, Brazil, Panama, Costa Rica, Mexico on Pandanus, Dictyosperma, Cordyline, orange, lime, coffee, Gardenia, Ficus, etc. -----*articulatus* Morg.
- bb. Body with mesothoracic marginal spine not suddenly drawn out, twice as long as wide.
- c. Body with cephalic margin distinctly serrate; median pair of lobes quadrangular, entire, with rounded angles, longer than broad; second pair of lobes broader than long, rounded, distal margin oblique, sinuate or notched; third pair of lobes distant from second, spine-like, hooked, cephalic surface convex, caudal concave, not conical; pectinae as long as lobes, arranged 2, 2, 3, 4-6, those of each third incisura very broad; genacerores in two groups; calles present, mesal calles not fused.—*Aspidiotus* (*Selenaspidus*) *articulatus magnospinus* Newst.—Uganda, Africa.-----*magnospinus* Newst.
- cc. Body with cephalic margin entire; median pair of lobes broader than long, broadly rounded, entire or faintly notched; second pair of lobes similar in size and form to median pair, entire; third pair of lobes distant from second, spine-like, not hooked, cephalic and caudal margins concave or straight, as long as pectinae, length three times greatest width; pectinae subequal in length to lobes, arranged 2, 2, 3, 2, those of each third incisura broad; genacerores in two groups, 7-10; dorsal oraceratubae numerous.—South Africa on Euphorbia, Mimulus.-----*pertusus* Brain.
- aa. Body with cephalic margin crenulate with projections of two sizes, large projections with smaller ones interspersed; median pair of lobes with distal end bluntly pointed, distal portion of lateral margin suboblique, mesal and lateral notches faint to distinct, longer than broad; second pair of lobes longer than broad, distal end bluntly pointed, lateral margin oblique, mesal notch near distal end and lateral notch near middle of lateral margin; third pair of lobes longer than broad, pointed, spine-like; pectinae subequal in length to lobes, arranged 2, 2, 3, 4-6, those of median incisura distapectinae, others unapectinae, those of each lateris irregular; dorsal oraceratubae numerous; genacerores in two groups; mesothoracic marginal spine conical, blunt, greatest width equal to length.—Kamerun, Africa on palms.-----*kamerunicus* Lindgr.

## SPECIES OF DUPLASPIDIOTUS

- a. Pygidium with two pairs of paraphyses, cephalic end enlarged, knob-like, long pair between first and second pairs of lobes, pair about one-half this length between second and third pairs of lobes; median pair of lobes large, rounded at distal end, distinct lateral

notch; second and third pairs of lobes distinct, much smaller than median, rounded on mesal and distal margins, prominent lateral notch; each lateris with numerous tooth-like processes; plates short, arranged 0, 0, 2, 2; mesospiracerores 11, metaspiracerores 0; genacerores arranged in inverted U-shaped mass.—Ceylon on *Acalypha*...  
*irreptus* Ruth.

aa. Pygidium with three or four pairs of paraphyses.

- b. Pygidium with three pairs of paraphyses, strongly developed, ending in distinct knob; four pairs of lobes, median pair scarcely notched on mesal margin; second and third pairs of lobes narrower than median; lobes all of same general character, second and third pairs much decreased in size; each lateris cephalad of fourth pair of lobes serrate as if with many small lobes; anus distant from caudal margin; genacerores present; mesogenacerores and pregenacerores forming a continuous semicircle.—Natal, Africa on *Camellia*.-----*claviger* Ckll.
- b. Pygidium with four pairs of paraphyses, mesal pair located cephalad of median incisura, not enlarged at cephalic end, shorter than others, all other pairs with distinct ball-like enlargement, second pair longest, third and fourth pairs subequal, longer than first; median pair of lobes longer than broad, triangular, mesal and lateral notches; second and third pairs of lobes as long as median, much narrower, notched; lateres with triangular lobe-like projections; plates shorter than lobes, slender, arranged 2, 2, 3, 5; mesospiracerores 7-9; genacerores in form of horseshoe, slightly interrupted at middle, 17-23 on each side.—South Africa.-----*niger* Brain.

SPECIES OF PSEUDAONIDEA

a. Pygidium with four pairs of subequal lobes.

- b. Body of adult female twice as long as wide, tapering uniformly from constriction to caudal end; pygidium with median pair of lobes with sides subparallel, distal ends rounded, mesal and lateral notches; second, third, and fourth pairs of lobes similar in shape, each pair successively slightly smaller; pectinae deeply lacinate, arranged 2, 2, 3, 3, 0; each lateris with its margin irregularly serrate, with two deep notches, each bounded on cephalic side by tooth-like projection; genacerores 0-2 (21-24) 16-27, rarely with mesogenacerores, pregenacerores always most numerous; mesospiracerores 12-20; scale of adult female reddish brown, exuviae yellow.—Ceylon, East Indies, Mauritius, Japan, Java, Brazil, British Columbia on *Nothopegia*, *Dalbergia*, *Ficus*, orange, grape-fruit, "umame," mandarin.-----*trilobitiformis* Green.
- bb. Body of adult female oval, not twice as long as wide; genacerores (23-25) 10-11; mesospiracerores 15-17; scale of adult female almost pure white.—*Pseudaonidia trilobitiformis darutyi* Charm.—Mauritius, Seychelles, Liberia, Brazil on *Mangifera*, *Muraya*, *Euphoria*.---  
*darutyi* Charm.

- aa. Pygidium with four pairs of very unequal lobes; median pair of lobes projecting distinctly beyond others, broadly bluntly pointed, entire, as broad as long; second and third pairs of lobes similar, elongate, sides subparallel, bluntly pointed, entire, twice as long as wide; fourth pair of lobes short, as broad as long, bluntly rounded, entire; pectinae not deeply laciniate, arranged 2, 2, 3, 3, 0, mostly narrow distapectinae with few teeth; each lateris coarsely serrate with deep indentations; genacerores (30-42) 20-30; mesospiracerores 13-25; scale blackish brown with orange colored exuviae.—*Pseudaonidia duplex* Ckll., *Pseudaonidia rhododendri* Green, *Pseudaonidia rhododendri thearum* Fern.—India, Hawaiian Islands, Japan, California, District of Columbia on tea, Camellia, Eurya, Myrica, Olea, Rhus, camphor-tree, orange, rhododendron, "Uname," Azalea. -----*theae* Mask.

## SPECIES OF PSEUDAONIDIELLA

- Pygidium with four pairs of lobes; median, second, and third pairs with mesal and lateral notches; fourth pair with single notch; each lateris with two or three pectinae; mesospiracerores about 15; pregenacerores and postgenacerores of each side apparently fused to form single group consisting of 70-76 cerores.—Japan, California on Peony, Camellia, Rhododendron, Ilex, Thea.-----*paconiae* Ckll.

## SPECIES OF PARAONIDEA

- Pygidium with four pairs of lobes; median pair of lobes largest, others successively smaller, all with mesal margin straight, lateral margin oblique and notched; pectinae not conspicuously laciniate, arranged 2, 2, 3, 3, 0; paraphyses club-shaped, enlarged at cephalic end, three pairs, first and second pairs subequal, slightly longer than third pair; each lateris with prominent indentation; mesal portion of dorsum with large lattice-shaped area; anus distant from caudal margin; genacerores in two large curved groups of about 45; metathorax with lateral margins straight, narrower than portions of body cephalad and caudad of it.—Ceylon on Mimusops. -----*malleola* Green.

## SPECIES OF ENTASPIDIOTUS

- a. Pygidium with median pair of lobes entire.
- b. Pygidium with eleven plates or pectinae on each lateris; median pair of lobes entire, broader than long, broadly rounded; second pair of lobes as broad as median, entire, slightly oblique, broader than long; third pair of lobes longer than broad, lateral margin oblique with faint emargination; pectinae and plates arranged 2, 2, 3, 11, plates in incisurae, dagger-shaped, sometimes finely serrate on each lateris near third lobe; dorsal oraceratubae numerous; setae minute, shorter than lobes.—*Abyssinia* on Euphorbia. -----*magnus* Lindgr.
- bb. Pygidium always with considerably less than eleven plates or pectinae on each lateris.
- c. Pygidium with two pectinae or plates or less on each lateris.
- d. Pygidium with clearly defined more strongly chitinated tongue-shaped area on ventral aspect, pointing caudad; me-

- dian and second pairs of lobes similar, entire, truncately rounded, constricted, subequal in size; third pair of lobes minute, described as obsolete, pointed; pectinae subequal in length to lobes, arranged 2, 2, 3, 1, those of each third incisurae and each lateris broad, unapectinae, consisting of long distal projection and remainder broad area with short teeth; dorsal oraceratubae small, numerous, scattered; anus located slightly caudad of tongue-shaped area; lateres crenulate.—South Africa on Euphorbia.-----*euphorbiae* Newst.
- dd. Pygidium never with strongly chitinated tongue-shaped area; median pair of lobes oval, not very large; second pair of lobes subequal to median; third pair of lobes small; pectinae or plates arranged 2, 2, 3, 2, those of incisurae furcapectinae, those of each lateris broad obliquely truncate plates; lateres without teeth; dorsal oraceratubae numerous, arranged in rows; calles divided into four parts.—Cape Town, South Africa on Mesembryanthemum.-----*lounsburyi* Marl.
- cc. Pygidium with four pectinae on each lateris, pectina arranged 2, 2, 3, 4, all trilacinate; lobes four pairs, similar, median projecting, others decreasing regularly in size; lateris with teeth in three areas; spiracerores 7-8; dorsal oraceratubae large, conspicuous, arranged in rows; calles wanting.—Java on mango-steen and mango.-----*greeni* Marl.
- aa. Pygidium with median pair of lobes notched.
- b. Pygidium with three or more pectinae on each lateris adjacent to third lobe.
- c. Pygidium with median pair of lobes distinctly longer than broad, distal end bluntly rounded, mesal and lateral notches broad and shallow; second pair of lobes similar in form, smaller, distinct mesal and faint lateral notches; third pair of lobes longer than broad, dagger-shaped; pectinae subequal in length to lobes, arranged 2, 2, 3, 6-7, mesal projection of third incisurae spine-like plate, others unapectinae, those of each lateris irregular unapectinae; dorsal oraceratubae few.—Kamerun, Africa on Agelaia, Tricalysia. -----*gracilis* Lindgr.
- cc. Pygidium with median pair of lobes distinctly broader than long.
- d. Pygidium with width of third incisurae distinctly greater than total width of median pair of lobes and median incisura; median pair of lobes broader than long, distal end bluntly pointed, mesal and lateral notches deep; second pair of lobes longer than broad, lateral margin slightly oblique, mesal and lateral notches deep; third pair of lobes sharply pointed, spine-like; pectinae slightly longer than median lobes, arranged 2, 2, 3, 4, those of third incisurae, particularly two cephalic, broad distapectinae, those of each lateris very irregular; dorsal oraceratubae numerous.—Kamerun, Dutch East Africa and south Africa on Anacardiaceae, Bandelraea, Rinorea, Ficus, Aberia, Euonymus, Berberis, Chrysophyl-lum, tea, citrus, palms. -----*silaticus* Lindgr.



- dd. Pygidium with width of third incisura distinctly less than total width of median pair of lobes and median incisura; median pair of lobes quadrangular, distinct lateral and mesal notches, sides straight, subparallel; second pair of lobes longer than broad, faint mesal and lateral notches; third pair of lobes sharply pointed, spine-like; pectinae arranged 2, 2, 3, 2-3, those of each third incisura and lateris not or only slightly longer than third lobe; spiracerores wanting.—South Africa on *Phormium*. -----*pumilus* Brain.
- bb. Pygidium never with more than one pectina on each lateris, sometimes none.
- c. Pygidium with caudal pectina of each third incisura much narrower than others; median and second pairs of lobes similar in size and shape, distinct mesal and lateral notches, bluntly rounded between notches, proximal portion more or less constricted; third pair of lobes small, entire, as long as adjacent pectinae, shorter than other lobes, crenulate; pectinae subequal in length to lobes, arranged 2, 2, 3, 1-0, one on each lateris broad, adjacent to third lobe; setae small, short; dorsal oraceratubae numerous, tubes very long.—Southwest Africa on succulent plant. -----*schultzei* Newst.
- cc. Pygidium with caudal pectina of each third incisura as broad as one next to it; median and second pairs of lobes subequal, second pair slightly smaller, faint mesal and lateral notches, proximal portion more or less constricted; third pair of lobes pointed, as long as pectinae and other lobes; pectinae distapectinae, arranged 2, 2, 3, 1, subequal in length to lobes; setae inconspicuous.—South Africa on *Arthrosolen*.-----*griqus* Brain.

## SPECIES OF SCHIZASPIDIOTUS

Body with deep mesal incision at cephalic end and deep thoracic constriction apparently between prothorax and mesothorax and two others on caudal portion of preabdomen; median pair of lobes quadrangular, deep lateral and mesal notches with bluntly pointed projection between them, distant; second pair of lobes smaller than median, entire, distal end broadly rounded; pectinae deeply laciniate, longer than lobes, arranged 2, 2, 6 or more, one next each second lobe a broad pectina, others plates; anus slightly more than its width from caudal margin; vulva about same distance cephalad of anus.—Philippine Islands on *Ficus*. -----*lobata* Ckll. & Robs.

## SPECIES OF AMBIGASPIIS

Pygidium with median pair of lobes large, subtriangular, bluntly pointed, both margins crenulate; second pair of lobes bluntly rounded, mesal margin straight, lateral oblique, crenulate, broader than long; third pair of lobes twice as broad as long, short, mesal margin straight, lateral oblique, crenulate; plates dagger-like, longer than lobes, arranged 0, 0, 3, 5-7, those of each lateris broader, caudal three more than twice as long as those of third incisurae; anus and vulva situated at about same level; mesospiracerores and metaspiracerores 2-2;

lattice-shaped thickenings not strongly chitinized, seen with difficulty.  
—South Africa on *Lycium*. ----- *lycii* Brain.

SPECIES OF LATTASPIDIOTUS

- a. Pygidium with plates or pectinae in median incisura.
  - b. Pygidium with furcapectinae, wanting on lateres, furcapectinae distinctly divided, slightly longer than lobes, arranged 2, 2, 3, 0; median pair of lobes longer than broad, slightly constricted on proximal portion, mesal and lateral notches distinct, distal end bluntly rounded between them; second and third pairs of lobes long, narrow, twice as long as broad, distinct mesal and lateral notches; mesospiracerores 9-18, metaspiracerores (?)0; oracera-tubae large, arranged in longitudinal rows; body with cephalic portion bearing many large, widely separated setae; anus distant from caudal margin.—Uganda, Africa on *Baikaea*.--- *baikae* Newst.
  - bb. Pygidium with plates, one to three on each lateris, plates as long as or slightly longer than lobes, arranged 2, 2, 3, 1-3; median pair of lobes longer than broad, subtriangular, bluntly pointed, faint lateral notch; second and third pairs of lobes smaller than median, second smaller than third, subtriangular, faint lateral notch or entire; lateres with indentations and lobe-like projections; three pairs of paraphyses with cephalic end with ball-like enlargements, second and third pairs sometimes represented only by cephalic enlargements; anus located on line drawn through cephalic enlargements of second paraphyses, covered by cuticular flap, caudal margin of flap deeply emarginate.—South Africa on *Acacia*. ----- *laciniæ* Brain.
- aa. Pygidium without pectinae or plates in median incisura.
  - b. Pygidium with two plates in each second incisura; median pair of lobes quadrangular, entire, truncate with rounded angles; second pair of lobes smaller than median, broader than long, faint lateral notch, rounded; third pair of lobes broader than second pair, distinct mesal and lateral notches with rounded projection between them; each lateris with two pairs of dentate projections, generally larger than lobes; plates short, subequal in length to lobes, arranged 0, 2, 3; setae slightly longer than lobes; paraphyses in three pairs, mesal pair longest, lateral pair shortest, uniform in width throughout; mesospiracerores 4-4, metaspiracerores 1-2.—Barbados on grape.----- *fossor* Newst.
  - bb. Pygidium with one plate in each second incisura.
  - c. Pygidium with single plate on each lateris cephalad of third lobe, this plate about twice as long as median lobe, other plates subequal in length to lobes, arranged 0, 1, 3, 1; median pair of lobes broader than long, faint mesal and lateral notches; second pair of lobes short, broader than long, very faintly notched; third pair of lobes irregular in form, sometimes notched; setae very long and slender, especially cephalic ones; paraphyses in three pairs, distinctly knobbed at cephalic end, mesal and second pairs subequal, third pair oval in out-

line and one-half length of second.—Antigua, British West Indies, Java, Mauritius, Mexico on *Malvaviscus*, *Prunus*, *Vitis*...  
*tesserata* Charm.

- cc. Pygidium without plates on each lateris, plates inconspicuous, arranged 0, 1, 1-2, 0; median pair of lobes largest, usually broadly rounded, sometimes slight mesal and lateral notches; second and third pairs of lobes similar in shape, second pair larger than third, rounded at distal end, prominent lateral notch, slightly inclined caudad; each lateris with several sharp-pointed processes; paraphyses six in number, mesal and second pairs subequal, cephalic end of each enlarged, knob-like, third pair located cephalad of third pair of lobes, inconspicuous; oracreratubae arranged in longitudinal rows; setae long, increasing in length cephalad.—Ceylon on *Oreodoxa*, *Acalypha*. -----*oreodoxae* Ruth.

#### SPECIES OF PARTARGIONIA

Head with cephalic indentation; transverse constriction between mesothorax and metathorax, first and second abdominal segments, third and fourth abdominal segments, fifth segment and pygidium; pygidium with four pairs of tooth-like lobes; small setae between second and third, third and fourth pairs of lobes, and on each lateris; transverse thickening near middle of pygidium and with two projections on cephalic side.—India on *Artocarpus*.-----*artocarpi* Green.

#### SPECIES OF PARROTTIA

Pygidium with three pairs of lobes, third pair small and tooth-like; paraphyses two in number, associated with second incisurae; anal opening on line drawn through third pair of lobes, and one on each lateris.—India on *Grislea*. -----*moorei* Green

#### SPECIES OF NEOMORGANIA

- a. Pygidium with distal end of median pair of lobes serrate, oblique, proximal ends adjacent, distal ends distant, projecting but little beyond pygidial margin, other lobes obsolete; each lateris with three indentations, each with an oracreratuba; mesospiracerores 15, metaspiracerores 10; plates a single one on each lateris adjacent to median lobe.—New South Wales, Tasmania on *Eucalyptus*, *Acacia*, *Hakea*. -----*acaciae* Morgan.
- aa. Pygidium with median pair of lobes with distal ends entire; dorsal oracreratubae minute and limited to pygidium.
- b. Pygidium with median pair of lobes distinctly separated, oblique, entire; second and third pairs of lobes represented by mere teeth; each lateris with setae nearly as long as median pair of lobes; spiracerores apparently wanting.—Australia on *Eucalyptus*, *Casuarina*. -----*eucalypti* Mask.
- bb. Pygidium with median pair of lobes contiguous along mesal margin, oblique exteriorly, giving appearance of single mesal area or lobe.—Australia on *Acacia*. -----*functiloba* Mari.

SPECIES OF BAKERASPIS

Pygidium with median pair of lobes rounded, entire; second pair of lobes deeply incised, mesal lobelet larger than lateral, lobelets rounded, entire; third pair of lobes broad, not prominent, deeply concave at middle of distal margin; plates subequal in length to median pair of lobes, arranged 2, 2, 2, 2, those of each lateris placed far apart; lateres finely crenulate; preabdomen with lateral margin fringed with quadrate, serrate, scale-like projections; genacerores in two groups of about 150 cerores each.—Philippine Islands on *Schizostachyum*.-----  
*schizostachyi* Ckll. & Robs.

SPECIES OF GREENIELLA

- a. Pygidium of adult female triangular, as long as or longer than broad.
- b. Pygidium of second nymphal female with median pair of lobes with mesal and lateral notches.
  - c. Pygidium of second nymphal female with latapectinae or unapectinae, unequal in length; median pair of lobes elongate, distal end bluntly rounded, mesal and lateral notches; second and third pairs of lobes smaller, oblique, bluntly pointed, lateral margin serrate; pectinae longer than lobes, distapectinae and unapectinae, arranged 2, 2, 3, 1-2; each lateris with several, eight to ten, irregular, serrate, pectinae-like projections; pygidium of adult female with asymmetrically arranged projections, variable in form, frequently with two or three pairs of long irregular projections with smaller projections between them.—Ceylon on *Psychotria*.-----*cornigera* Green.
  - cc. Pygidium of second nymphal female with broad distapectinae, subequal in length; median pair of lobes elongate, much longer than wide, distinct mesal and lateral notches, distal end prolonged and rounded between notches; second pair of lobes similar in size and shape to median; third pair of lobes smaller, similar in size and shape to second pair; pectinae slightly longer than lobes, arranged 2, 2, 3, 6-7, those of median incisura furcapectinae, of second and third incisurae narrow distapectinae, of lateres broad distapectinae; incisurae with seven allaceratubae-like oraceratubae; pygidium of adult female triangular, elongate; median pair of lobes elongate, parallel sides, distinct lateral and mesal notches; second pair of lobes elongate, dagger-like, pointed; plates and pectinae arranged 2, 1, 0, those of median incisura plates or furcapectinae, others distapectinae; lateres undulate and finely serrate; setae minute.—Kamerun, Africa on *Schotia*, *Crudia*, *Cynometra*.-----*biafrae* Lindgr.
- bb. Pygidium of second nymphal female with median pair of lobes entire, elongate, distal end oblique, and continuous with lateral margin; second pair of lobes short and broad, bluntly pointed, subtriangular, entire; pectinae short with shallow lacinations, arranged 2, 2, 3, those of each lateris placed in an indentation cephalad of each second lobe; lateres with prominent serrate pectina-like or plate-like projections; pygidium of adult female with

- pygidial margin with asymmetrical small projections, never with long paired projections.—Ceylon on *Mesua*. -----*mcssuae* Leon.
- aa. Pygidium of adult female not triangular, distinctly broader than long.
- b. Pygidium of second nymphal female with pectinae or plates wanting in median incisura.
- c. Pygidium of adult female with distinct serrate or deeply lacinate pseudolobes.
- d. Pygidium of adult female with narrow, distinctly lacinate pectina-like pseudolobes, pseudolobes arranged in groups with two or three small tooth-like projections between them; setae long, subequal in length to pseudolobes; pygidium of second nymphal female with three pairs of similar, subequal, elongate lobes, mesal notch wanting, lateral notch deep and distinct; pectinae as long as or longer than lobes, arranged 0, 2, 2, 8.—India on *Walsura*.-----*dentata* Lindgr.
- dd. Pygidium of adult female with three pairs of pseudolobes, distinctly projecting, broader than long, all similar in size and form, distal margin uniformly deeply serrate; other smaller pseudolobes placed between larger, arranged 2, 2, 3, 2; lateres except pseudolobes named, without projections; pygidium of second nymphal female with median pair of lobes short, twice as broad as long, distal margin with five tooth-like projections; second pair of lobes similar to median, shorter; third pair of lobes short, smaller than second pair, irregular; pectinae arranged 0, 2, 2, 1, broad distapectinae; incisurae with six altaceratuba-like oraceratubae.—South Australia on *Casuarina*. -----*paradoxa* Lindgr.
- cc. Pygidium of adult female not with lacinate pseudolobes, with three pairs of projections, lobe-like in form and arrangement, margin of each with two prominent indentations; each side with five flask-shaped plate-like projections, arranged one in second and third incisurae and three equidistant on lateres, attached by broad base; setae particularly of lateres, long and slender, longer than lobe-like projections; pygidium of second nymphal female with three pairs of lobes, median pair large, subadjacent, deep lateral notch, distal end bluntly pointed; second and third pairs of lobes smaller, with deep distal notch; plates or pectinae wanting; setae longer than median lobes.—Burma on *Millusa*. -----*targionopsis* Lindgr.
- bb. Pygidium of second nymphal female with pectinae or plates in median incisura.
- c. Pygidium of adult female with lobes or pseudolobes.
- d. Pygidium of adult female with two pairs of more or less distinct lobes.
- e. Pygidium of adult female with pair of short, crenulate, lobe-like projections; each lateris with one or two short, lobe-like extensions, each bearing setae, margin of lateres finely crenulate; pectinae much longer than median lobe-

like projections, arranged 1, 1; setae long, particularly median pair; pygidium of second nymphal female with median pair of lobes projecting, bluntly rounded, distinct lateral notch; second pair of lobes subtriangular, blunt, lateral notch; third pair of lobes triangular, pointed; pectinae long, deeply laciniate, much longer than lobes, arranged 2, 2, 3, 3-4, those of lateres smaller than those of incisurae; incisurae with altaceratubae-like oraceratubae; anus twice its width from caudal margin.—Natal on Euphorbia. -----*austro-africana* Lindgr.

- ee. Pygidium of adult female with distinct lobe-like lobes; median pair of lobes subadjacent, mesal margins subparallel, bluntly rounded, lateral margin oblique, two or three lateral notches; second pair of lobes broadly rounded, twice as broad as long, slight mesal and lateral emarginations; plates shorter than lobes, truncated, arranged 0, 2, 8, those of each lateris arranged 3-1-1-1-1; setae long and stout; pygidium of second nymphal female with median pair of lobes longer than broad, rounded, lateral notch; second pair of lobes similar in form and subequal in size; third pair of lobes much smaller, bluntly rounded, longer than broad, lateral notch; pectinae about as long as lobes, arranged 2, 2, 3, 7, those of median incisura furcapedinae, those of other incisurae and adjacent to third lobe broad distapedinae, others more pointed and irregular in form, those of each lateris arranged 3-2-2; setae as long as lobes; incisurae with altaceratubae-like oraceratubae.—India on Mimusops.-----*spinosissima* Lindgr.

- dd. Pygidium of adult female without lobes, but with pectina-like pseudolobes.

- e. Body of adult female entire, not crenulate; pygidium of adult female hyaline, without lobes, provided with twenty-four long pectina-like pseudolobes; anus located about three times its length from caudal margin; anus and vulva superimposed; pygidium of second nymphal female with pectinae arranged 2, 2, 3, 3, equal in length with lobes; each lateris with an acute lobe-like projection cephalad of pectinae; median pair of lobes widest at middle, lateral and slight mesal notch; second pair of lobes with lateral notch; third pair of lobes with lateral and mesal notches.—Ceylon on Mesua. -----*ferreae* Ruth.

- ee. Body of adult female with margin with deep rounded crenulations; pygidium without lobes, but with about seven elongate deeply laciniate pectina-like pseudolobes, one located on meson; margin of pygidium between pseudolobes distinctly dentate; pygidium of second nymphal female with median pair of lobes elongate, longer than broad, rounded, mesal and lateral notches; second and third pairs of lobes similar in form, larger; fourth pair

of lobes subequal in size, somewhat irregular in form; fifth pair of lobes triangular, pointed; pectinae longer than lobes, deeply laciniate, arranged 2, 2, 3, 3, 3, 2; setae minute, not as long as lobes; margin apparently with eight altaceratuba-like oraceratubae.—India on *Aglaia*.-----

*viridis* Lindgr.

- cc. Pygidium of adult female without lobes or pseudolobes, with about five slight undulations, margin serrate; setae minute, inconspicuous; pygidium of second nymphal female with median pair of lobes large, elongate, subquadrangular, rounded, distinct lateral notch; second pair of lobes similar in size and form to median lobes; third pair of lobes one-third size of second pair, bluntly pointed; pectinae about as long as lobes, arranged 2, 2, 2, 2, those of each lateris adjacent third lobe and broader than others; lateres irregularly dentate.—New Caledonia on *Podocarpus*.-----*longa* Lindgr.

#### SPECIES OF AONIDIA

- a. Pygidium of adult female without lobes and with pseudolobes, second nymphal female with three pairs of lobes.
- b. Pygidium of second nymphal female known.
- c. Pygidium of second nymphal female with pectinae arranged 2, 2, 3, 0; pectinae with sides parallel, subequal in length to lobes; lobes conspicuous, three pairs, lateral and mesal margins parallel, distal margin crenulate, pygidium of adult female with mesal depression on caudal margin on each side of which occasionally short wide faint lobes can be identified.—West Australia on *Banksia*.-----*banksiae* Fuller.
- cc. Pygidium of second nymphal female with pectinae arranged 0, 2, 2, 12, each lateris completely fringed with narrow distapectinae, pectinae not longer than lobes; median pair of lobes elongate, much longer than wide, mesal margin straight, distal and lateral margins continuous curve, notched; second and third pairs of lobes similar to median; pygidium of adult female with numerous asymmetrical narrow lobe-like projections with plate-like projections at their distal end.—Ceylon on *Ficus*.-----*planchonioides* Green.
- bb. Pygidium of second nymphal female unknown.
- c. Pygidium of adult female always with lobe-like or plate-like projections, although sometimes small.
- d. Pygidium of adult female with mesal lobe-like projection.
- e. Pygidium of adult female with truncate mesal projection bearing three small spine-like setae; two conical projections on each side cephalad of mesal projection, equidistant from each other and mesal projection, each bearing one comparatively long and two short setae; margin of pygidium with low, broad, inconspicuous, lobe-like projection just cephalad of each projection, minutely serrate; anus and vulva located near middle of pygidium.—Ceylon on *Mesua*.-----*perplexa* Green.

- ee. Pygidium of adult female with mesal truncate projection not bearing setae, sides constricted, much smaller triangular lobe-like projection on each side and adjacent to mesal projection; margin of pygidium adjacent to these latter projections with three or four rounded prominences; anus large and prominent, not adjacent to margin; scale yellow with a whitish secretion which persists only as a marginal fringe; first nymphal exuvia deciduous.—Ceylon on Carissa. -----*pusilla* Green.
- dd. Pygidium of adult female never with mesal projection.
  - e. Pygidium of adult female with margin with six minute thorn-like projections, arranged hook-like, three on each side of meson extending laterad; margin cephalad of projections entire or gently crenulate; setae minute; anus located slightly caudad of middle of pygidium; scale dull reddish-brown, roughened with innumerable, slender, curved, spine-like projections that are not soluble in caustic potash.—Ceylon on Hemicyclia.-----*echinata* Green.
  - ee. Pygidium of adult female never with minute hook-like projections with long slender pseudolobes.
    - f. Pygidium of adult female not with laciniate pseudolobes.
      - g. Pygidium of adult female with pseudolobes clavate, pair on meson, pair on each side of these and distant from mesal pair, adjacent to and cephalad of each of these on each side, a broad triangular lobe-like projection, then three clavate projections, a broad triangular lobe-like projection, and finally three irregular clavate projections; anus located about midway between vulva and caudal margin, four times its width from caudal margin; caudal end of pygidium truncate.—Ceylon on Psychotria.-----*spatulata* Green.
      - gg. Pygidium of adult female with large number of long, slender, dagger-shaped pseudolobes, distal end always pointed, never clavate; setae of one surface nearly as long as pseudolobes and of other surface minute, hardly projecting beyond margin; anus located near and caudad of vulva.—Spain on Billardia.---*picca* Leon.
    - ff. Pygidium of adult female with median pair of pseudolobes prolonged into laciniate processes with deeply serrate distal ends, other lobes and here and there on margin with smaller similar projections; setae spine-like, few in number; females not excreting any definite and separate scale, congregated in numbers under general mass of thin, whitish, curling, cottony threads; second exuvia much larger than adult female.—Australia on Syncarpia. -----*syncarpiae* Mask.
  - cc. Pygidium of adult female without lobe-like or plate-like pro-



jections; margin of pygidium irregularly crenulate; dorsal and ventral surface with few irregularly distributed oracera-tubae; anus large, circular, located near middle of pygidium; pygidium of second nymphal female resembling species of *Parlatoria* or *Gymnaspis*; scale of male and first nymphal female, when present, with number of long curling glassy brittle processes of wax.—Australia on *Callistemon*.-----*pulchra* Green.

- aa. Pygidium of adult female with symmetrically arranged projections, apparently lobes and not pseudolobes.
- b. Pygidium of adult female with more than two pairs of lobes.
  - c. Pygidium of adult female with four pairs of lobes, pygidium transverse with caudal margin subtruncate; median pair of lobes narrow, subquadrangular, mesal and lateral notches; second pair of lobes projecting farther caudad than median lobes, similar in shape, mesal and lateral notches; third and fourth pairs of lobes successively shorter than each other and second pair of lobes, mesal and lateral notches; plates slender, hardly longer than lobes, arranged 2, 3, 5, 5, 6, those of lateres adjacent to fourth pair of lobes; cephalic end of body with deep mesal cleft.—Ceylon on *Loranthus*.-----*loranthi* Green.
- cc. Pygidium of adult female with three pairs of lobes and pygidium semicircular, caudal margin uniformly convex, never subtruncate; median pair of lobes distant, bluntly pointed, subtriangular, entire; second pair of lobes similar in shape to median pair, more than twice as far from median as distance between median pair of lobes, entire; third pair of lobes minute, similar to second pair; plates of second and third incisurae twice or more as long as lobes, arranged 2, 3, 3, 2, those of lateres adjacent to third pair of lobes; each lateris with two indentations; cephalic end of body entire, not cleft.—Ceylon on *Loranthus*.-----*obscura* Green.
- bb. Pygidium of adult female with two pairs of lobes.
  - c. Pygidium of adult female without pectinae or plates; median pair of lobes contiguous at proximal end, bluntly pointed, triangular, lateral margin with two notches; second pair of lobes small, triangular, entire; each lateris with three equidistant setae and two broad emarginations or indentations; pygidium of second nymphal female with three pairs of lobes, median pair not contiguous, mesal margins straight, distal and lateral margins continuously rounded, notched; second pair of lobes broader, deeper lateral notch; third pair of lobes bluntly pointed, triangular, lateral margin serrate; pectinae narrow distapectinae, arranged 2, 2, 2, 2, those of each lateris distant from third lobe width of lobe; each lateris coarsely crenulate.—Europe on *Laurel*.-----*lauri* Bouche.
  - cc. Pygidium of adult female with median pair of lobes separated by pair of long, slender, plate-like pseudolobes, twice as long as lobes; median and second pairs of lobes long, slender, sides parallel, two or three times as long as wide; second incisura with long, broad, dagger-like plate and one or two cephalad of each second lobe; plate-like projections variable in size

and form; setae long, three on each side, one near to and cephalad of each lobe, and near middle of each lateris; anus located near cephalic part of pygidium; margin of segments of preabdomen distinctly toothed.—Java on *Myristica*.-----  
*javanensis* Green.

SPECIES OF XEROPHILASPIS

Pygidium of adult female with two pairs of small subequal lobes, broader than long, margin rounded, entire; median incisure normal, one-half width of second; pectinae or plates wanting; setae minute, shorter than lobes; ceratubae small, not abundant; anus four times its width from caudal margin and once from vulva; calles obsolete; pygidium of second nymphal female with median pair of lobes large, subtruncated, angles rounded, as long as broad, protuberant, entire; second pair of lobes similar in form to median, smaller; third pair of lobes four or five times as broad as long, mesal margin straight, lateral margin oblique, emarginate, slightly crenulate; plates small, shorter than lobes, arranged 0, 1, 1, 0; anus over eight times its width from caudal margin.—Arizona on *Prosopis*.-----*prosopidis* Ktll.

SPECIES OF PHAULASPIS

- a. Pygidium of adult female transverse, truncated, hardly projecting beyond the margin; preabdomen fringed with six small equidistant setae, minutely serrate; pygidium of second nymphal female with single pair of lobes; median pair of lobes elongate with slightly converging sides, bluntly pointed, entire, distant; pectinae or plates wanting; each lateris with three deep indentations limiting areas with prominent caudal angles; each median lobe and each of two caudal projections bearing two setae; mesospiracerotes present.—Australia on *Hakea*.-----*hakeae* Mask.
- aa. Pygidium of adult female transverse, truncated, distinctly projecting beyond the margin, entire, deep mesal incision; lobes, pectinae or plates, and setae wanting; pygidium of second nymphal female with four simple lobes, scarcely projecting, extending cephalad paraphysis-like, adjacent, inconspicuous; cephalad of lobes two large deep inconspicuous clefts; pectinae or plates wanting; pygidium of first nymph with two lobes with single deep cleft on each side.—Gymnaspsis grandis Green.—Seychelles on *Lodoicea*.--*grandis* Green.

SPECIES OF ANCEPASPIS

Pygidium of adult female strongly narrowed at middle; lobes and pectinae or plates wanting; caudal margin with two deep, narrow, parallel emarginations, extending for one-half length of narrowed portion; mesal portion between emarginations with rounded angles, bearing single seta on each side near caudal end of emarginations; each lateral portion bordering emargination narrower than mesal, angulate at caudal end; anus about eighteen times its width from caudal margin and once from vulva; body cephalad of constricted portion broadly rounded; pygidium of second nymphal female rounded, entire, two undulations where median lobes usually located with emargination between; setae minute, more numerous than in adult; anus six times its width from caudal margin; lobes and pectinae or plates wanting; pygidium of first nymph without lobes, short setae, and anal setae.—Arizona on *Prosopis*.-----*tridentata* Ferris.

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#### CHANGES

The discovery that certain names used on previous pages were preoccupied was not made until too late to insert other names in their place. The following need to be changed:—

Douglasia to Douglariella

Greenella to Greenacoccus

Paragreenia to Neogreenia

Hemiaspis to Hemaspidis

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